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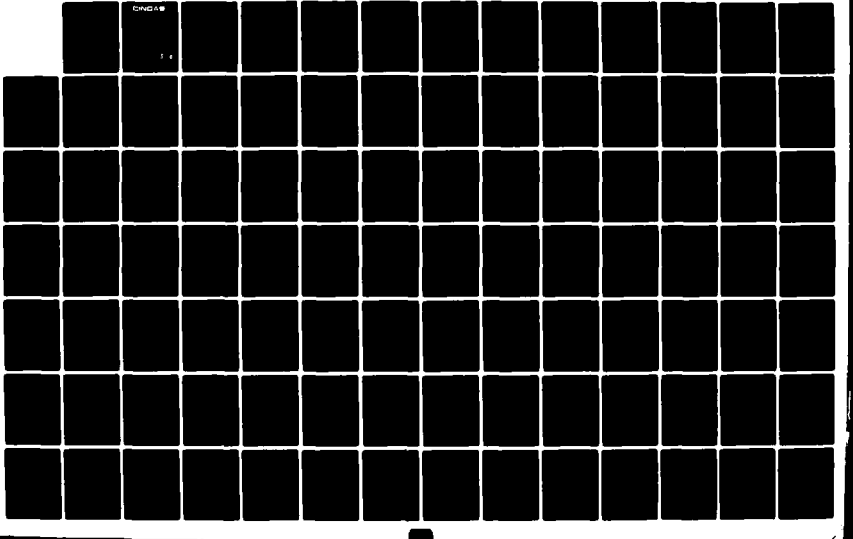

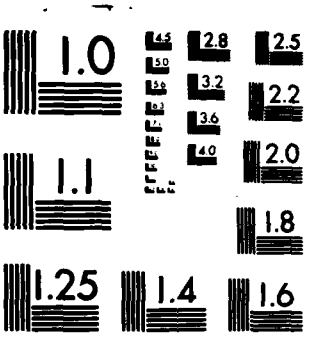

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REFRACTIVE INDEX OF ALKALINE EARTH HALIDES AND ITS WAVELENGTH AND TEMPERATURE DERIVATIVES

By
H. H. LI

CINDAS REPORT 44

September 1977

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ABSTRACT

Available data on the refractive index and its temperature derivative for alkaline earth halides were exhaustively surveyed, compiled, and analyzed. The most probable values of the refractive index at 293K for the transparent region were generated for the materials for which experimental data were sufficiently abundant and reliable. Provisional values were also generated for the wavelength regions where available data were less abundant. Reasonable estimations of refractive index for the very scantily measured materials were made by incorporating the dielectric constants and wavelengths of absorption peaks into a simplified dispersion equation.

It was found that of the twenty alkaline earth halides only seven, namely, MgF_2, CaF_2, SrF_2, BaF_2, $CaCl_2$, $SrCl_2$, and $BaCl_2$, appear in the open literature with refractive index measurements. Most of the available data are for the first four of the seven materials. Temperature derivatives of refractive index for most of the alkaline earth halides were unavailable. As a result, data analysis on dn/dT was limited to CaF_2, SrF_2, and BaF_2.

Key Words: refractive index; temperature coefficient of refractive index; optical constants; alkaline earth halides.

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LIST OF SYMBOLS

a	Constant
A, A_0, A_1, A_2	Constant, code for Abele method
b	Constant
B	Code for Brewster angle determination method
c	Constant; velocity of light
C	Code for polarization method
D	Code for deviation method; sodium line of 0.589 μm
F	Code for focal length method
H	Code for high frequency modulation method
I	Code for interference method
L	Code for multilayer method
M	Code for immersion method
n	Refractive index
n	Refractive index of short (uv) wavelengths oscillator
P	Electrical polarizability; code for Pulfrich refractometer measurement
R	Code for reflection method
S	Code for thickness determination method
T	Temperature; code for transmission method
v	Phase velocity of light in medium
V	Volume
α	Linear thermal expansion coefficient

γ	Damping factor
ε	Complex dielectric constant
ε_1	Real part of ε
ε_2	Imaginary part of ε
ε_0	Static dielectric constant
ε_∞	Optical dielectric constant
κ	Extinction coefficient; oscillator strength
λ	Wavelength of light
λ_i	Wavelength of the ith absorption band
λ_I	Wavelength of infrared absorption band
λ_u	Effective wavelength of ultraviolet absorption band

1. INTRODUCTION

The purpose of this work is to present and review the available data and information on the refractive index of alkaline earth halides, to critically evaluate, analyze, and synthesize the data, and to make recommendations for the most probable values of the refractive index, its wavelength derivative $dn/d\lambda$, and temperature derivative dn/dT. The recommended and provisional values generated cover the widest possible transparent wavelength ranges and are for the purest form of each alkaline earth halide for which measurements have been made. However, for the materials which have been scantily measured, reasonable estimations are made.

The introductory text describes the general procedures and methods for the evaluation and synthesis of the available data and for the generation of recommended values. It also discusses the present status of the experimental data and other considerations concerning the body of data.

In the theoretical background section, the general theory of the refractive index and its temperature derivative is discussed. Correlations of the dielectric constants, absorption bands, and the refractive index are described.

In the data presentation section we treat each material separately, review the available data and information, and

describe the considerations involved in arriving at the final assessment and recommendation and the theoretical guidelines or semi-empirical correlations on which the data analysis and synthesis are based. Figures and tables follow to present the recommended values, the original data, specimen characterization, and measurement information. At present, we have compiled 182 sets of data extracted from some 80 documents in the primary literature. Distribution of the available data sets is shown in table 1.

In the conclusion, figures are presented in which all the recommended curves on the refractive index, $dn/d\lambda$, and dn/dT are grouped for visual comparison. The accomplishments in this work are discussed and the need for further work is suggested.

The last section consists of the source references used in the extraction of data and/or information. Only original sources of data have been used in the analysis. The effective cut-off date for literature research was May 1977, while the earliest referenced source was dated 1874. With such a comprehensive compilation of information and presentation of results, the author believes that scientist and engineer in the optical trade will find this report useful in regard to refractive index and its temperature and wavelength derivatives.

In order to utilize any dispersive medium, spectroscopists must have a knowledge of the index of refraction and $dn/d\lambda$ for all wavelengths transmitted by the medium. Such data are also

TABLE 1. AVAILABLE DATA SETS

Material	Number of data sets		
	n	dn/dT	$n_o - n_e$
MgF_2	42	2	7
CaF_2	42	28	
SrF_2	10	4	
BaF_2	15	12	
$CaCl_2$	7		
$SrCl_2$	7		
$BaCl_2$	6		

useful to physicists for evaluating theoretical dispersion equations and for studying the forces between the constituents of the crystal. For a transparent medium, the refractive index, n, is defined as the ratio of the velocity, c, of electromagnetic radiation of a given wavelength in vacuum to the phase velocity, v, in the medium, i.e.,

$$n = c/v. \tag{1}$$

Since the index of refraction of air is about 1.0003, n is conventionally measured with respect to air instead of vacuum and no correction is made. In a non-absorbing medium the refractive index is a real quantity, while in an absorbing medium a complex index of refraction, N, is used. The complex index is defined as

$$N = n + ik, \tag{2}$$

where k is the extinction coefficient or absorption index. Both n and k are frequency dependent. The real and imaginary parts of the square of the complex refractive index are the real and imaginary parts of the complex dielectric constant, ε, of the medium:

$$\varepsilon = \varepsilon_1 + i\varepsilon_2 = N^2 = (n^2 - k^2) + i2nk. \tag{3}$$

The dispersion in an optical material is intimately related to the microscopic structure of the material. In the short wavelength side transmission is limited by electronic excitation, and for long wavelengths by molecular vibrations and rotations. The width of the transparent spectral range increases as the energy for electronic excitation is increased and that for molecular vibrations is decreased. Theoretical and experimental

studies on ionic crystals indicate that crystals having small ions with strong bonding have a wide spectral range of transparency. This is true for alkali halides and alkaline earth halides.

Unlike the alkali halides, which form only cubic crystals, the alkaline earth halides form crystals with a variety of structures. The four types of structure that are found in the alkaline earth halides are indicated in table 2. A review of tables 1 and 2 will show that, with the exception of MgF_2, only crystals of cubic structure have been investigated.

Calcium fluoride in its naturally-occuring form is known as fluorite. It is conventional to describe a crystal as having the fluorite structure if its lattice is similar to that of calcium fluoride. In a fluorite-structure crystal of a compound AB_2 each ion of species A is surrounded by eight equivalent nearest-neighbour ions of species B forming the corners of a cube with A at its center. Each ion of species B is surrounded by a tetrahedron of four equivalent A ions. More fundamentally, the structure has a face-centered-cubic translational group and a space lattice of symmetry O_h^5. If the structure is interpreted in terms of a primitive cube of side a, it comprises three interpenetrating face-centered-cubic lattices. The first is a lattice of species A with its origin at the point (0,0,0) and with primitive translational vectors (0,a/2,a/2); (a/2, 0, a/2); and (a/2,a/2,0) in the cube of side a. The B species are located on

TABLE 2. CRYSTAL STRUCTURE OF ALKALINE EARTH HALIDES

Material	Structure
BeF_2	Tetragonal, Orthorrhombic, Hexagonal
$BeCl_2$	Orthorrhombic
$BeBr_2$	Orthorrhombic
BeI_2	Orthorrhombic, Tetragonal
MgF_2	Tetragonal
$MgCl_2$	Hexagonal
$MgBr_2$	Hexagonal
MgI_2	Hexagonal
CaF_2	Cubic
$CaCl_2$	Othorrhombic
$CaBr_2$	Othorrhombic
CaI_2	Hexagonal
SrF_2	Cubic
$SrCl_2$	Cubic
$SrBr_2$	Tetragonal
SrI_2	Hexagonal
BaF_2	Cubic
$BaCl_2$	Cubic, Orthorrhombic
$BaBr_2$	Orthorhombic
BaI_2	Orthorhombic

two further lattices with similar translational vectors but with origins at (a/4, a/4, a/4) and at (3a/4, 3a/4, 3a/4). The site of the A ion has O_h^5 symmetry and the site of the B ion has T symmetry. The interstitial site again has O_h^5 symmetry, being at the center of a cube of eight B ions. The crystal is not piezoelectric.

It is apparent that the fluorite structure provides close contact between the different species of atom or ion. Furthermore if the ions of species A are sufficiently large, close contact between the ions of species B is prevented. If the constituent species are regarded as hard spheres with radii r(A) and r(B), contact occurs between the A and B ions to the exclusion of B-B contact and of A-A contact [1] when the radii satisfy the condition

$$4.45 > r(A)/r(B) > 0.73.$$

The energetic advantages of close contact between dissimilar ions suggest that the fluorite structure will be favoured by those strongly ionic compounds with formula AB_2 which possess large ions of type A. Study of a self-consistent table of ionic radii, such as that of Zachariasen [2] summarized in table 3, shows that one is unlikely to find a hypothetical compound in which contact between A ions could occur. This would require that the A ions be exceptionally large, with

$$r(A) > 4.45r(B).$$

In fact, the A ions are normally relatively small and it is

TABLE 3. THE CRYSTAL RADII OF IONS

Be^{2+}	0.30A	F^-	1.33A
Mg^{2+}	0.65A	Cl^-	1.81A
Ca^{2+}	0.94A	Br^-	1.96A
Sr^{2+}	1.10A	I^-	2.19A
Ba^{2+}	1.29A		

possible to find several series of compounds in which the lower limiting value is passed, and contact between B ions can occur. For example, among the halides of barium one finds that the fluorite lattice structure occurs for the smaller halide B ions while the iodides possess orthorhombic or sheet-like structures.

Among the compounds of alkaline earth halides those which possess the fluorite structure are, according to Wyckoff [1], CaF_2, SrF_2, BaF_2, $CaCl_2$, $SrCl_2$, $BaCl_2$. The absence of bromides and of iodides may be interpreted in terms of a violation of the radius requirement, the anions being relatively too large. It is apparent on inspection of table 3 that close contact between A and B ions cannot occur for the light cations.

There were two major reasons why only crystals of cubic structure have been investigated. The first is that cubic crystals are optically isotropic. It is true that optical anisotropy is highly desirable in a number of special uses, but for the fabrication of optical components in general, anisotropy of dispersion may become an objective. It is therefore understandable that early investigations were limited to the cubic crystals, but it is surprising that even at the present age of modern technology our knowledge of optical dispersion is still limited to that of cubic crystals. With regard to the dispersion of the non-cubic crystals, little work has been reported.

The second reason for inattention to non-cubic alkaline earth halide crystals is the unavailability of the crystals or

their undesirable chemical and physical properties, such as hygroscopy and softness. With advances in the technique of crystal growth, crystals which do not occur naturally are made available in workable sizes. Examples are BeF_2 [3], $MgCl_2$ [4], and $BaBr_2$ [5]. However, no measurements on the optical dispersion of these crystals are reported.

The applications of high-power infrared lasers, which are now being developed at a rapid rate, are partly limited by the lack of suitable transparent optical materials. As a result, much of the high-power laser research is directed toward finding acequate high-temperature window and dome materials in the wavelength regions from 2 to 6 micrometers and near 10.6 micrometers. The alkaline earth halides have large transmission ranges spreading from the ultraviolet to the infrared and are available in large sizes and high purity. They are good materials for photochemists and spectroscopists who are interested in ultraviolet transparency, and for laser scientists who are concerned with infrared transmission. They are considered good window materials and are recommended by the National Materials Advisory Board [6]. Through the studies of the Advisory Board, crystals of fluorite-type are among the serious candidates for laser materials. Efforts are being made to improve their mechanical strength and thermal endurance without altering their optical properties, particularly the refractive index.

The available refractive indices of alkaline earth halides and their temperature derivatives have been surveyed and studied from time to time by a number of investigators, including Smakula [7], Ballard [8], Coblentz [9], to name just a few. Refractive index data are compiled in a number of handbooks such as those sponsored by Landolt-Bornstein [10], AIP [11], and CRC [12], etc. However, their main concern is to provide a general picture through a few particular sets of data. The purpose of the present work is quite different from that of the above-mentioned works. It has two major aims: (1) to exhaustively search the open literature so that a complete and comprehensive bibliographic reference is compiled, and (2) to generate recommended values based on the existing experimental data on the refractive index and its temperature derivative, so that evaluated and/or synthesized numerical data are made available for scientific and engneering use.

In figure 1, a schematic view of the absorption spectrum of a typical alkaline earth halide crystal is shown. At the right, at about 30 micrometers, are seen the absorption peaks associated with optical phonons, while nearer to the left, at about 0.1 micrometer, are seen the absorption peaks associated with excitons. In the transparent region between the two extremes the crystal absorbs little light and has a dispersion which can be characterized by an optical dielectric constant $\varepsilon_\infty = n_0^2$, where n_0 is the refractive index at short wavelength. In absorbing regions of the spectrum, the imaginary part of ε is non-zero.

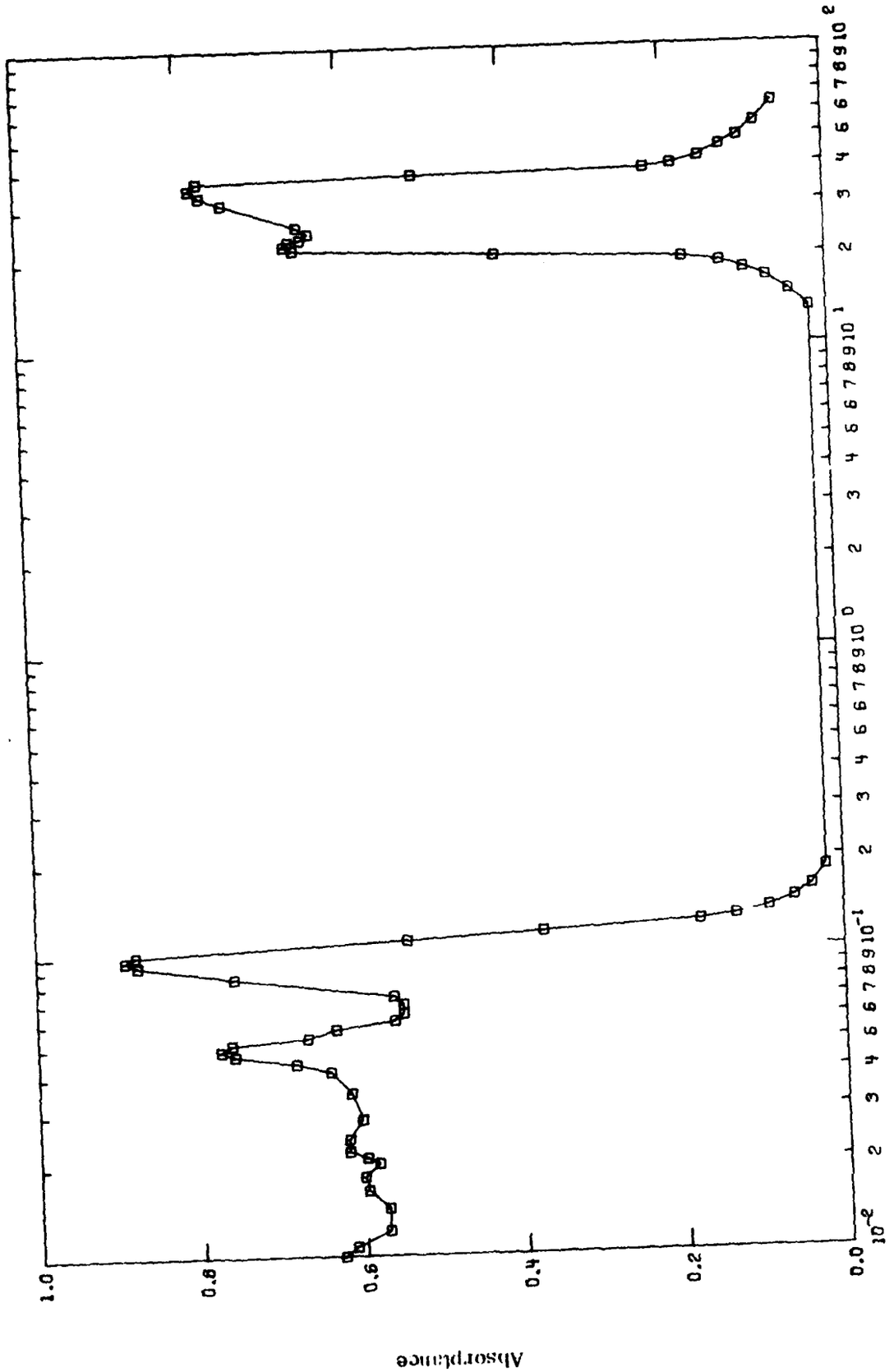


Figure 1. Absorption Spectrum of an Alkaline Earth Halide Crystal

Both the real and imaginary parts of ε can be obtained from the experimental reflectivity (preferably over a wide range of wavelengths) and the use of the Kramers-Kronig relation or the Lorentz oscillator model. In optical technology, the refractive index is needed only for the transparent region of the material. One does not have to carry out a complicated analysis and calculation to obtain the refractive index. Direct methods are available for high precision measurements. The minimum deviation method is usually used to obtain the refractive index accurate to the fourth decimal place, and the interference method to the third.

Scanning the open literature, one finds that in most cases the measurements of refractive index were carried out at various temperatures and reduced to a reference temperature chosen according to the investigators' preference. It is highly desirable to reduce the existing refractive index data and to present them at a uniform reference temperature. It is therefore important that the temperature derivative of the refractive index be made available in the form of a function of wavelength based on the existing data and theory, so that the users can easily calculate the required values over a limited range of temperature.

The first task in generating recommended values was to analyze the data on the temperature derivative of refractive index. With the analyzed values of dn/dT, all the refractive

index data were then reduced to the reference temperature of 293K chosen for the present work. The corrected data were then subjected to evaluation and critical selection. Least-squares fitting of the selected data to a given equation was then carried out.

Recommended values for refractive index and the corresponding wavelength and temperature derivatives, $dn/d\lambda$, and dn/dT, have been calculated from the correlating equations where sufficient experimental values are available. However, for the region where experimental evidence is either insufficient or poor, only provisional values are provided. Data for the transparent region are presented at integral wavelengths with small increment. Intermediate values can be obtained by the following linear interpolations:

$$n_{\lambda'} = n_{\lambda} + (dn/d\lambda)_{\lambda} (\lambda' - \lambda),$$
$$n_{\lambda T'} = n_{\lambda T} + (dn/dT)_{\lambda} (T' - T). \qquad (4)$$

The second expression in eq (4) is based on the fact that dn/dT is relatively independent of temperature over a fairly wide range of temperatures. However, the application of this expression should be limited to the temperature range 293±50K.

II. THEORETICAL BACKGROUND AND EMPIRICAL RELATIONS

The study of the propagation of light through matter, particularly solids, comprises one of the important and interesting branches of optics. The many and varied optical phenomena exhibited by solids include selective absorption, dispersion, double refraction, polarization effects, and electro-optical and magneto-optical effects. Many of the optical properties of solids can be understood on the basis of classical electromagnetic theory.

The macroscopic electromagnetic state of matter at a given point is described by four quantities:

(1) the volume density of electric charge,

(2) the volume density of electric dipole strength, called the polarization,

(3) the volume density of magnetic dipole strength, called the magnetization,

(4) the electric current per unit area, called the current density.

All of these quantities are macroscopic averages over the microscopic variations due to the atomic makeup of matter. They are related to the macroscopically averaged electric and magnetic fields by the well-known Maxwell equations [13].

Detailed discussion of Maxwell's equations is beyond the scope of the present work. What we should bear in mind is that the general solution of Maxwell's equations is made up of

electric and magnetic fields. In the treatment of the interaction of light and matter, the light is considered as an oscillating electric field that engulfs the component molecules of matter. Each of the molecules may be considered to be a charged simple harmonic oscillator. When these component oscillators are driven by the engulfing electric field of the light they emit Huygens-like spherical wavelets that contribute to and modify the electric and magnetic fields. In the early development of the theory of propagation of light in matter, there was no practical alternative to treating the matter as a collection of charged harmonic oscillators subject, perhaps, to damping forces. Fortunately, the modern developments in the theory of matter and its interaction with radiation have shown that this simple model has broad utility, and that it can be employed in the discussion of refractive indices. In this section, only a brief summary of results of the theory of the refractive index and its temperature derivative is given.

2.1 REFRACTIVE INDEX

Maxwell's theory gives the relationship

$$n^2 = \varepsilon = 1 + P, \tag{5}$$

where n is the refractive index, ε the dielectric constant, and P the polarizability. If one treats the material as equivalent to a collection of harmonic oscillators resonant to radiations of various wavelengths λ_i, one can derive [13] the equation

$$n^2 - 1 = \sum_i \frac{c_i \lambda^2}{\lambda^2 - \lambda_i^2}, \qquad (6)$$

where λ is the wavelength of the incident radiation, and c_i is a constant which depends on the number of oscillators per unit volume or the "oscillator strength" of the oscillators resonant at wavelength λ_i. Equation (6) is generally called the Sellmeier formula. It can be derived by modern quantum theory from more sophisticated models of the solid, with λ_i denoting the wavelengths of the various absorption bands of the material.

For the transparent region, it was traditionally believed that the dispersion formula of the Sellmeier type best fit the ionic crystals. The consequence of this was that most of the early experimental works adopted eq (6) with the λ_i's and c_i's as adjustable empirical constants chosen only to fit the data, with no other experimental and theoretical basis. Nevertheless, this equation, if used correctly, gives a good deal of information concerning the position of absorption bands, oscillator strengths, and the dielectric constant for a static field.

For the transparent region, eq (6) can be written as

$$\epsilon = n^2 = 1 + \sum_i \frac{a_i \lambda^2}{\lambda^2 - \lambda_i^2} + \sum \frac{b_j \lambda^2}{\lambda^2 - \lambda_j^2} \qquad (7)$$

Terms in the first summation are contributions from the ultraviolet absorption bands and those in the second from the infrared absorption bands. In the infrared region, however, the λ_i's of uv absorption peaks are much smaller than λ and eq (7) is reduced to

$$\epsilon = \epsilon_\infty + \Sigma \frac{b_j \lambda^2}{\lambda^2 - \lambda_j^2}, \qquad (8)$$

where $\epsilon_\infty = 1 + \Sigma a_i = \epsilon_0 - \Sigma b_i$ is the optical dielectric constant.

Real crystals are neither perfectly linear dielectrically, nor are they perfectly harmonic. The effect of non-linearity and anharmonicity is to introduce a damping term [14]. Equation (8) is extended to become

$$\epsilon = \epsilon_1 + i\epsilon_2 = \epsilon_\infty + \sum_j \frac{b_j \lambda^2}{\lambda^2 - \lambda_j^2 - i\gamma_j \lambda} \qquad (9)$$

Equation (9) is widely used in investigating the infrared optical properties of ionic crystals. In the transparent wavelength region, the effects contributed by absorption bands are negligibly small. In such cases the damping terms can be omitted and eq (9) is reduced to the Sellmeier formula.

In an ideal application of eq (7), one would need to know the wavelength of all of the absorption peaks. This is very difficult in practice because of the large number of absorption peaks. In fact, only a few absorption peaks are accessible for experimental observation. In order to include the effects due to unobserved absorption bands on the refractive index in the transparent region, an equation similar to eq (7) is used to interpret the experimental data:

$$n^2 = A + \sum_i \frac{a_i \lambda^2}{\lambda^2 - \lambda_i^2} + \sum_j \frac{b_j \lambda^2}{\lambda^2 - \lambda_j^2}, \qquad (10)$$

where λ_i's and λ_j's are the observed wavelength of absorption

bands. A is a constant which equals the quantity $1+\Sigma a_k$ where a_k's are the coefficients of the ultraviolet terms with λ_k's much smaller than the wavelengths in the transparent region. In the infrared region, the dominant contribution to the refractive index in the transparent region comes from the fundamental phonons, while other absorption bands contribute little effect on the refractive index in the transparent region. As a result, in most cases, only one or two terms due to the predominant contribution are included in eq (10). The relationships between the dielectric constants and the coefficients in the dispersion equation remain with no change:

$$\epsilon_\infty = A + \Sigma a_i, \tag{11}$$

$$\epsilon_0 = A + \Sigma a_i + \Sigma b_j. \tag{12}$$

For some materials, experimental data on n are insufficient to justify the least-squares fitting. A means should be developed to obtain reasonable estimates by use of the available data for other properties which are related to n. The following simplified equation (two-oscillator model) of the Sellmeier type is proposed for this purpose:

$$n^2 = A + \frac{(\epsilon_\infty - A)\lambda^2}{\lambda^2 - \lambda_u^2} + \frac{(\epsilon_0 - \epsilon_\infty)\lambda^2}{\lambda^2 - \lambda_I^2}, \tag{13}$$

where A is an adjustable parameter, λ_u the unweighted averaged value of the wavelengths of the ultraviolet absorption peaks, and λ_I the wavelength of the fundamental infrared absorption peak.

The adjustable parameter A in eq (13) can be determined even if only one measurement of n is available because the quantities ε_0, ε_∞, λ_u, and λ_I are in general available.

It is clear that the parameters ε_∞, ε_0, λ_u and λ_I play important roles in the calculations of the refractive index. On account of this, these parameters were also included in our searches, though not in an exhaustive way. Listed in tables 4, 5, and 6 are the results of our searches for ε_∞, ε_0 and λ_I.

The values of optical dielectric constant listed in table 4 are determined either by curve fit of refractive indices to the dispersion equation or by Kramers-Kronig analysis of reflection spectra. No method is designed for direct measurement of ε_∞. As a consequence, the accuracy of ε_∞ depends largely on the accuracies of input refractive indices and on the spectral range covered. It is interesting to note that at a given temperature the values of ε_∞ obtained from various sources are in close agreement. Although the values are made available at several temperatures, the paucity of data hampers the estimation of temperature variation of the optical dielectric constant.

The values of static dielectric constants given in table 5 indicate discrepancies between investigators. Such discrepancies can be attributed to the different methods used and the impurity contents of the samples. Without question, the results reported by Andeen et al [17] are the best, because the method of substitution is by far the most reliable direct means of

TABLE 4. OPTICAL DIELECTRIC CONSTANT OF ALKALINE EARTH HALIDES

Material	Temperature (K)	ε_∞	Author[2]
MgF_2	300	1.9(o)[1]	Barker[14]
	300	1.9(e)	Barker[14]
CaF_2	4	2.05	L
	80	2.047	B
	200	2.044	B
	300	2.040±0.001	B
	300	2.045	K
	300	2.04	L
	350	2.04	L
SrF_2	4	2.08	L
	80	2.07	B
	300	2.07	K
	300	2.07	L
	350	2.07	L
BaF_2	4	2.18	L
	80	2.157±0.001	B
	300	2.150	B
	300	2.16	K
	300	2.17	L
	350	2.17	L

[1] The letters o and e in the parentheses indicate the ordinary-ray and extraordinary-ray respectively.

[2] The capital letters in this column carry the following abbreviations:
L - Lowndes [15],
B - Bosomworth [16],
K - Kaiser et al [17].

TABLE 5. STATIC DIELECTRIC CONSTANT OF ALKALINE EARTH HALIDES

Material	Temperature (K)	ε_0	Author[2]
MgF_2	300	4.87(o)[1]	D
		4.6 (o)	Barker [14]
		4.926±0.01(o)	A
	300	5.45(e)	D
		5.4 (e)	Barker [14]
		5.501±0.01(e)	A
	300	5.26(p)	D
		5.1 (p)	Kodak [20]
		5.289(p)	A
CaF_2	4	6.47±0.03	L
	80	6.38±0.08	B
	80	6.51±0.03	L
	200	6.53±0.09	B
	200	6.66±0.03	L
	300	6.7 ±0.3	K
	300	6.63±0.08	B
	300	6.81±0.03	L
	300	6.78±0.03	R
	300	6.35±0.06	J
	300	6.8120±0.0007	A
SrF_2	4	6.15±0.03	L
	80	6.04±0.08	B
	80	6.19±0.03	L
	200	6.30±0.03	L
	300	6.6 ±0.3	K
	300	6.20±0.07	B
	300	6.50±0.03	L
	300	6.48±0.03	R
	300	6.4679±0.0006	A
BaF_2	4	6.96±0.03	L
	80	6.86±0.09	B
	80	7.01±0.04	L
	200	7.16±0.04	L
	300	7.2 ±0.4	K
	300	6.94±0.08	B
	300	7.12±0.04	L
	300	7.28±0.04	R
	300	7.02±0.07	J
	300	7.3605±0.0007	A

[1] The letters o, e and p in the parentheses indicate the ordinary-ray, extraordinary-ray, and polycrystaline.

[2] The capital letters in this column carry the following abbreviations: D - Duncanson [18], A - Andeen et al [19], L - Lowndes [15], B - Bosomworth [16], K - Kaiser et al [17], R - Roa and Smacula [21], J - Jones [22].

TABLE 6. SPECTRAL POSITION OF THE FUNDAMENTAL OPTICAL PHONON OF ALKALINE EARTH HALIDES

Material	Temperature (K)	λ_{TO} (Micrometer)	λ_{LO} (Micrometer)	Author[2]
MgF_2	300	22.2,		
		24.2,		
		40.6(o)		Barker [14]
	300	18.0,		
		25.0(e)		Barker [14]
CaF_2	5	37.04±0.19	20.66±0.10	L
	80	37.45±0.28		B
	100	37.00±0.19		L
	200	37.45±0.19		L
	300	38.9	21.6	K
	300	38.02±0.19	20.75±0.10	L
	400	38.76±0.19		L
	500	39.53±0.20		L
SrF_2	5	43.76±0.22	25.19±0.13	L
	80	44.44±0.40		B
	100	43.86±0.22		L
	100	44.64		D
	200	44.25±0.22		L
	300	45.05±0.23	25.32±0.13	L
	300	46.1	26.74	K
	300	45.66		D
	400	46.30±0.23		L
	500	47.39±0.24		L
BaF_2	5	52.63±0.26	28.90±0.14	L
	80	52.91±0.56		B
	100	52.63±0.26		L
	200	52.91±0.26		L
	300	53.33±0.27	29.07±0.15	L
	300	54.3	30.67	K
	400	54.20±0.27		L
	500	55.56±0.28		L

[1] The letters o and e in the parenthesis indicate the ordinary-ray and extraordinary-ray respectively.

[2] The capital letters in this column carry the following abbreviations:
L - Lowndes [15],
B - Bosomworth [16],
K - Kaiser et al [17],
D - Denham et al [23].

measuring the static dielectric constant and the samples they used are believed to be the purest available. However, the work of Lowndes [15] is important, because not only do his values at room temperature agree closely with those of Andeen et al, but also his measurements cover a wide temperature range, as shown in figure 2. In fact, his measurements give the only set of reliable dielectric constants as a function of temperature, a very important basis for determining the temperature variation of static dielectric constants.

The spectral position of the fundamental optical phonon, λ_I, is an important input parameter in the dispersion equation for the materials with scanty infrared data. Among the data listed in table 6, the values reported by Lowndes are most reliable and might used in our correlation of physical properties to calculate the missing refractive indices. However, as the values from a number of other papers agree closely with Lowndes', the averaged values will actually be used. Lowndes' measurements not only are believed to be the most reliable ones available but also are used to evaluate the temperature variation of λ_I. Such variations are indispensible input parameters for estimating the temperature derivative of the refractive index. Figures 3 presents Lowndes results of $\lambda_I(T)$.

The uv absorption of alkaline earth halides is quite complicated. There are many absorption peaks of about equal strength, spreading into a wide uv region from about 10 eV down

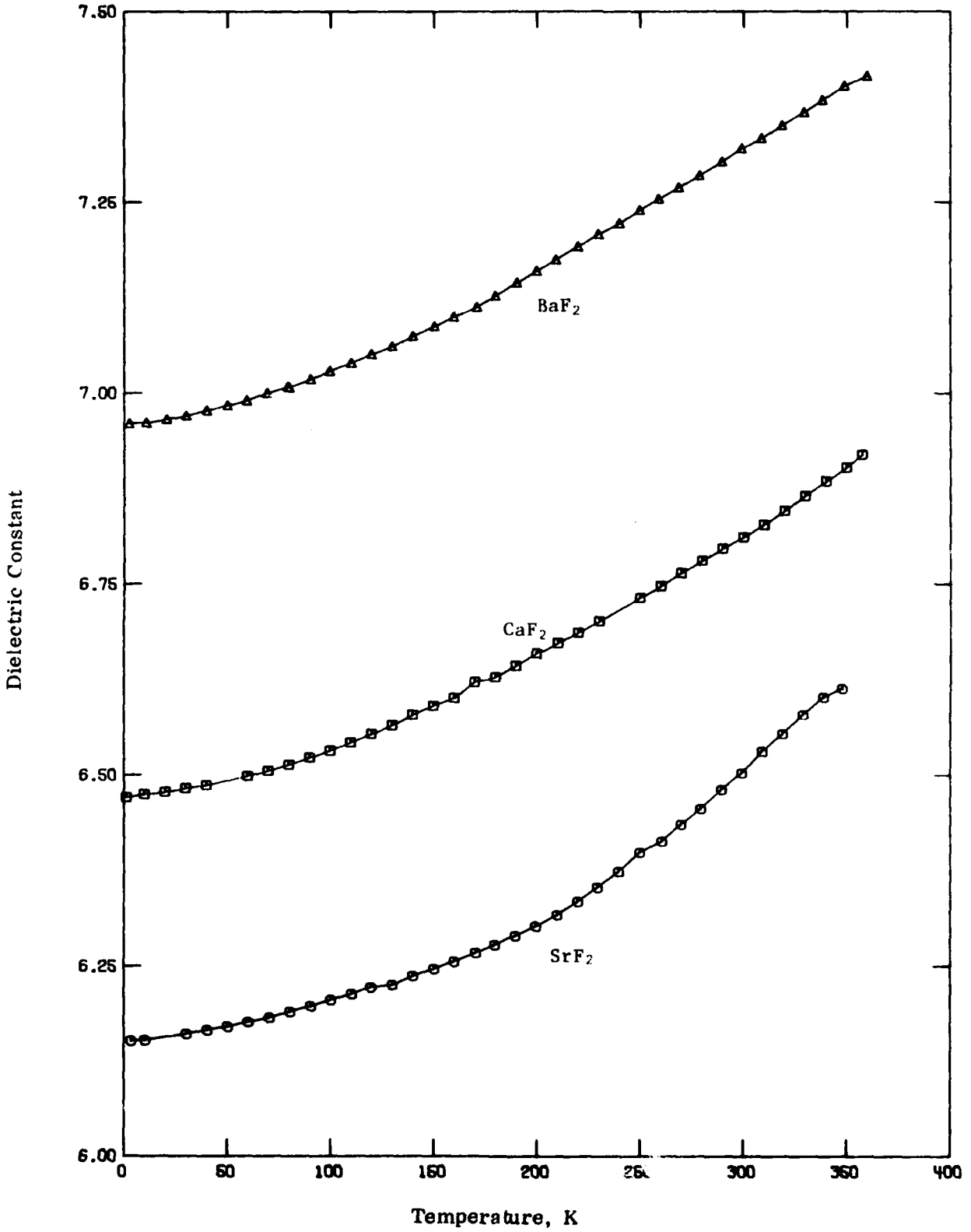


Figure 2. Temperature dependence of the Static Dielectric Constant of Alkaline Earth Fluorides [15]

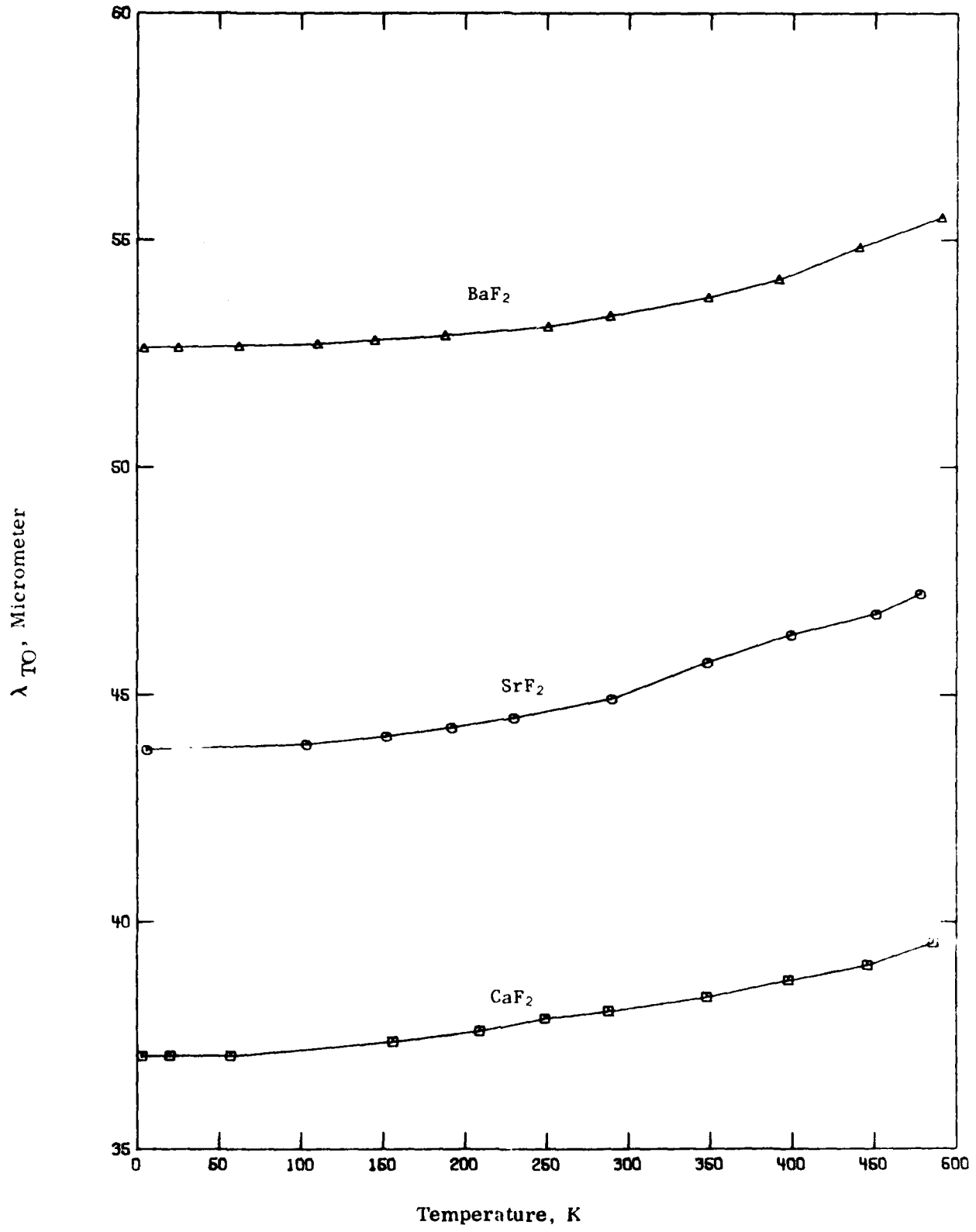


Figure 3. Temperature dependence of the Wavelength of Fundamental Transverse Optical Phonon of Alkaline Earth Fluorides [15]

to 35 eV. There is no direct measurement of absorption peaks available in the vacuum uv region because there experimental work is difficult. To estimate the effective wavelength, λ_u, of vacuum uv absorption, we have to relay on the observed far uv reflection spectra. It is accepted that corresponding to each of the peaks of a reflection spectrum there is an absorption peak at somewhat shifted wavelength; the sharper the peak, the less the shift. The far ultraviolet spectra of alkaline earth fluorides have been studied by Rubloff [24], Nisar and Robin [25] etc. . Rubloff's work is used in the present work because his observations were made at several discrete temperatures. This feature opened the possibility of estimating the temperature variation of λ_u. Figures 4, 5, and 6 show his results for the normal reflection spectra of CaF_2, SrF_2 and BaF_2 crystals in the far ultraviolet. For clarity, a vertical shift of 0.0175, respectively separating the 90k spectra (above) and the 400k spectra (below) from the spectra taken at 300k, were made in these figures. According to Rubloff, the spectral regions marked in each of the spectra with I, II, and III correspond respectively to:

I. excitation of an electron from the upper valence bands to the lower conduction bands,

II. excitation of an electron from the outermost core states of the metal ion,

III. interband and ionizing transitions of core electrons.

Shifts in energy with temperature are observed and are determined

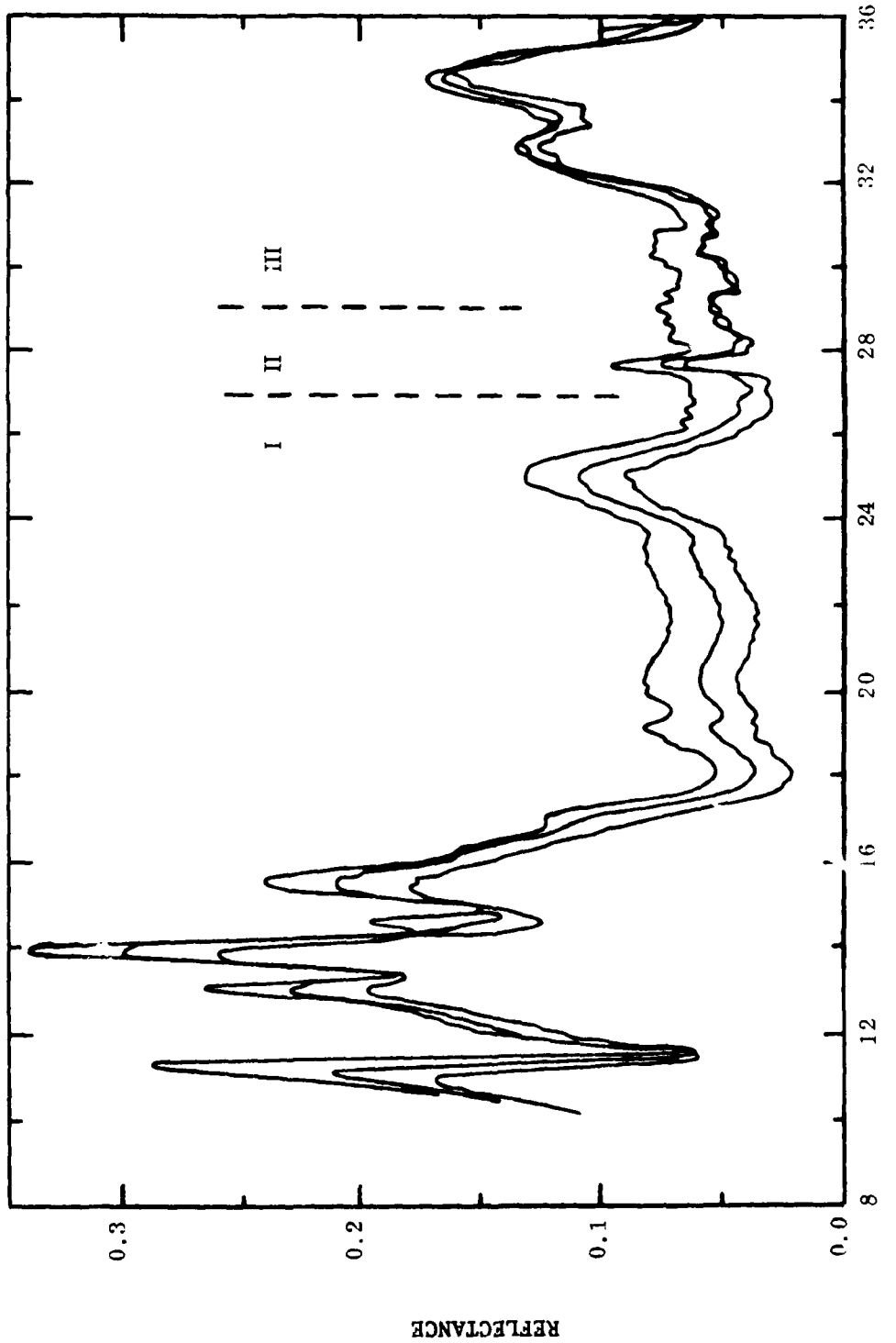


Figure 4. Near-Normal Incidence (6°) Reflectance Spectrum of CaF_2 Crystal in the Far Ultraviolet [24].

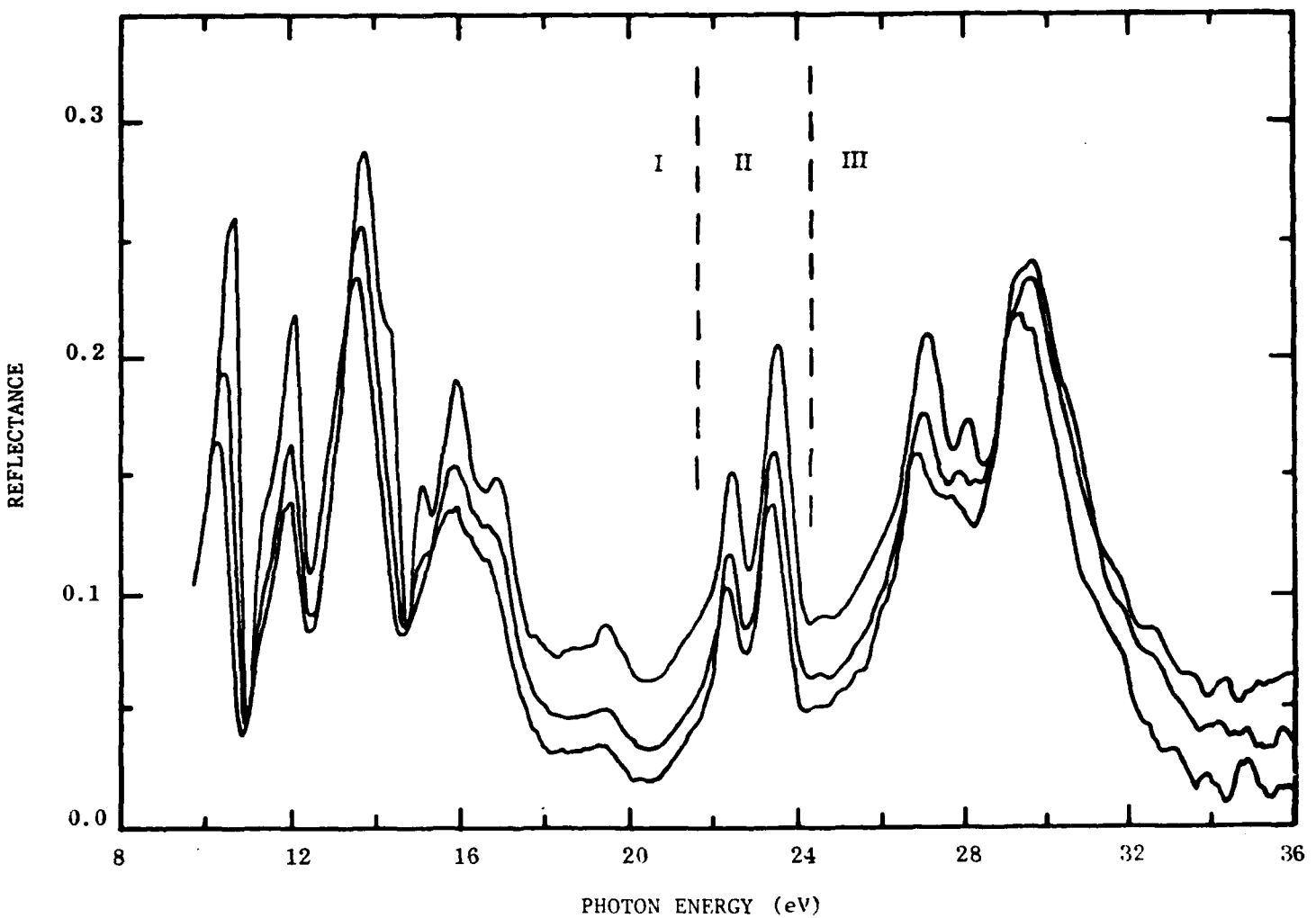


Figure 5. Near-Normal Incidence (≈6°) Reflectance Spectrum of SrF_2 Crystal in the Far Ultraviolet [24].

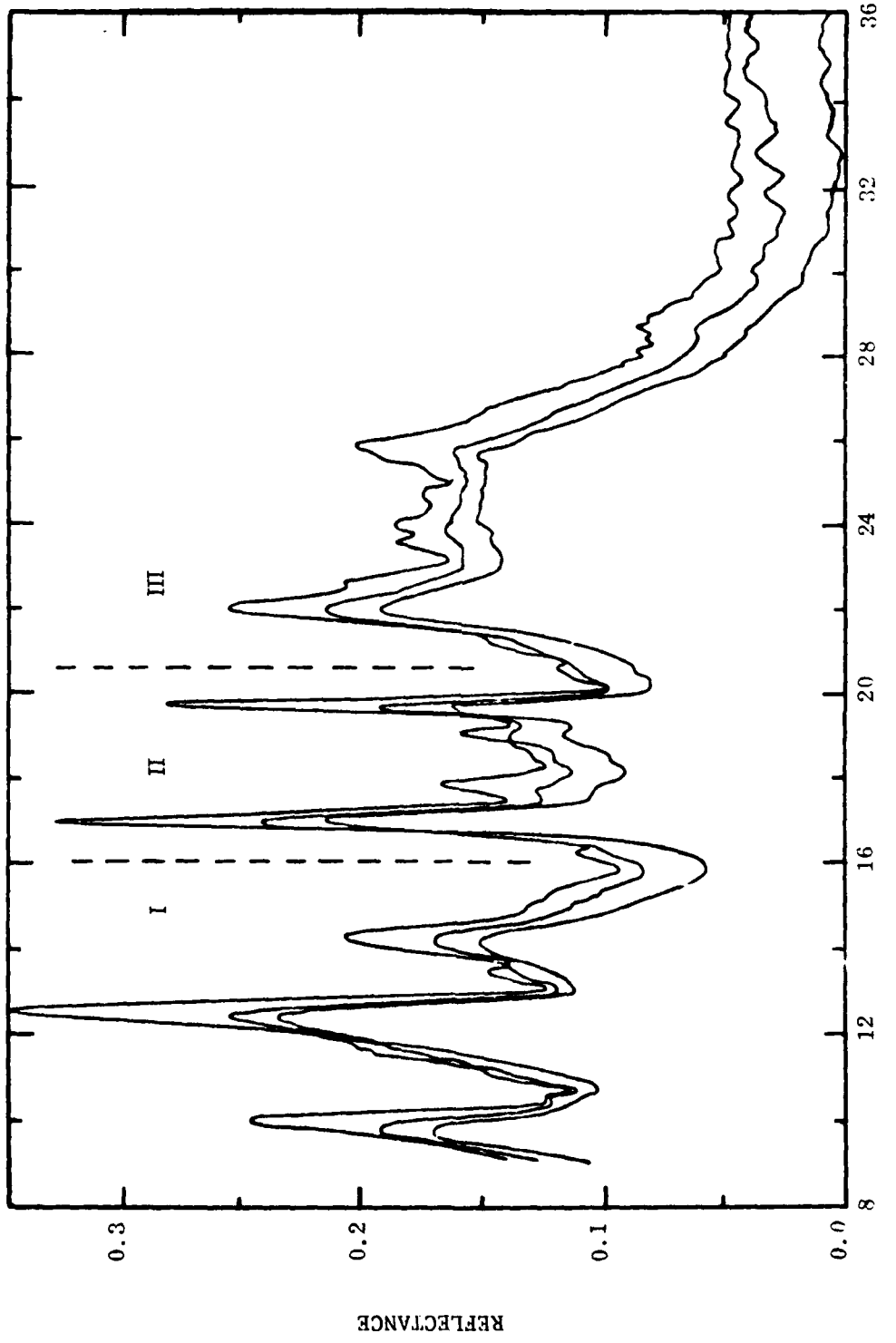


Figure 6. Near-Normal Incidence (≈6°) Reflectance Spectrum of BaF_2 Crystal in the Far Ultraviolet [24].

for sharp peaks. The energies of such peaks at various temperatures are given in table 7, from which the room temperature effective wavelength, λ_u, can be estimated. The results are: λ_u=0.09315 micrometer for CaF_2, λ_u=0.09566 micrometer for SrF_2 and λ_u=0.10205 micrometer for BaF_2. These values will be used as guidelines in the data analysis.

2.2 Temperature Derivative of Refractive Index, dn/dT

For users of the refractive index, information on the temperature derivative, dn/dT, is indispensable. The temperature dependence of the refractive index of crystals is of considerable interest in connection with a wide variety of optics applications. In the area of high-power lasers, dn/dT plays an important role in thermal lensing problems. A great deal of research effort is spent in finding the magnitude of dn/dT and its frequency dependence in the laser wavelength regions.

With regard to the thermo-optical behavior of the alkaline earth halides, the existing data are not useful. Much of the data is for two materials, CaF_2 and BaF_2, and is concentrated in limited spectral regions, the visible and near ultraviolet. Outside these regions, especially in the infrared, limited data are available, a very discouraging fact to workers in laser research. It is, therefore, highly desirable to obtain a theoretical prescription which allows prediction of dn/dT over a wide range of wavelengths, based on at most a small number of

TABLE 7. TEMPERATURE DEPENDENCE OF THE ENERGIES OF SHARP REFLECTANCE PEAKS (AFTER RUBLOFF)

Material	Peak Energy(eV)		
	90K	300K	400K
CaF_2	11.18	11.02	10.85
	13.04	12.97	12.92
	13.93	13.86	13.79
	15.53	15.40	15.37
	25.10	25.05	25.00
	27.70	27.75	27.75
	32.85	32.85	32.85
	34.50	34.50	34.50
SrF_2	10.60	10.41	10.27
	12.02	11.98	11.91
	13.71	13.61	13.55
	15.86	15.85	15.80
	22.47	22.42	22.37
	23.56	23.50	23.46
	27.14	27.10	26.95
	29.70	29.70	29.40
BaF_2	10.00	9.80	9.76
	12.66	12.44	12.46
	14.34	14.20	14.24
	17.10	17.09	17.09
	19.19	19.12	19.14
	19.89	19.81	19.80
	22.13	22.05	22.10

experimental measurements.

Ramachandran [26] presented a semiempirical theory of thermo-optical effects in crystals, in which the dispersion was fitted to experimental data, employing a series of oscillator frequencies and strengths as adjustable parameters. A close correlation was found between temperature shifts of various parameters and those of the fundamental oscillator frequencies. Unfortunately, the parameters chosen were rather numerous and often physically obscure or not unique; no general prescription was presented for determining their temperature variations, which are necessary for calculating dn/dT. Tsay, Bendow, and Mitra[27] introduced a two-oscillator model which accounts for the variation with temperature of the energy gap (electronic contribution to dn/dT) and the fundamental phonon frequency (lattice contribution to dn/dT). This model seems to fit the infrared data, but it does not agree well with the existing data in the uv region. A somewhat modified approach is to formulate a semi-empirical equation which serves the dual purpose of giving a good fit to existing data and a reasonable prediction of missing information.

Unlike the case of alkali halides, dn/dT data for the alkaline earth halides are not abundant enough to establish an observable trend of data among materials. This leaves us no choice but to resort to the existing theories. The following terms appear in various theories of dn/dT:

(1) A constant, A_0, representing the total effect of contributions other than those considered explicitly in other terms.

(2) A term arising from thermal expansion of the crystal. Various theories yield the same expression, $-3\alpha(n^2-1)$, for this term, where α is the linear thermal expansion and n the refractive index corresponding to the wavelength under consideration.

(3) A term due to thermal shift of the uv resonant wavelength. Starting from the two oscillator model, it is found that this contribution is

$$(\varepsilon_\infty - A)\,\frac{\lambda^4}{\lambda_u}\,\frac{d\lambda_u}{dT}\Big/(\lambda^2 - \lambda_u{}^2)^2$$

where λ_u is the effective wavelength of uv absorption bands. In some theories λ_u is replaced by ω_g, the frequency corresponding to the gap energy of the crystal. To evaluate this term requires knowledge which is in general not accurate or is missing. In cases where there are sufficient dn/dT data for the uv region, one can determine this quantity through curve fitting. We shall consider the quantity

$$(\varepsilon_\infty - A)\,\frac{1}{\lambda_u}\,\frac{d\lambda_u}{dT}$$

as an adjustable parameter A_1 in the data-fitting calculation.

(4) A term due to the thermal shift of the optical phonons. This contribution can be evaluated using the expression

$$(\varepsilon_\infty - \varepsilon_\infty)\,\frac{\lambda^4}{\lambda_I}\,\frac{d\lambda_I}{dT}\Big/(\lambda^2 - \lambda_I{}^2)^2,$$

where λ_I corresponds to the wavelength of the TO optical phonon. The quantities ϵ_∞, ϵ_0, and λ_I are in general available in the literature and $d\lambda_I/dT$ can be estimated from Lowndes' work (see figure 3). Therefore there is no unknown parameter in this term.

(5) A term due to the thermal variation of the transverse effective charge, e*. This term is proportional to the expression

$$(\epsilon_0 - \epsilon_\infty)\,\frac{1}{e^*}\,\frac{de^*}{dT}\Big/(\lambda^2 - \lambda_I^{\,2}).$$

Theoretical treatments and direct measurements of de^*/dT do not appear to exist. There is therefore no alternative but to estimate the effect of this contribution by fitting the dn/dT data to the dn/dT formula with

$$(\epsilon_0 - \epsilon_\infty)\,\frac{1}{e^*}\,\frac{de^*}{dT}$$

as an adjustable parameter A_2.

The following equation summarizes the five contributions mentioned above:

$$2n(dn/dT) = -3\alpha(n^2 - 1) + A_0 + \frac{A_1\lambda^4}{(\lambda^2 - \lambda_u^{\,2})^2} + \frac{A_2\lambda^2}{\lambda^2 - \lambda_I^{\,2}} + \frac{2(\epsilon_0 - \epsilon_\infty)\lambda^4}{(\lambda^2 - \lambda_I^{\,2})^2}\left(\frac{1}{\lambda_I}\,\frac{d\lambda_I}{dT}\right). \tag{14}$$

In the case of CaF_2, SrF_2, and BaF_2, the quantities ϵ_0, λ_I, $\frac{d\lambda_I}{dT}$ are made available by Lowndes [15], and ϵ_∞ is available from the literature. Although λ_u and $d\lambda_u/dT$ can be estimated from Rubloff's [24] observations on the reflection spectra at

various temperatures, it will be prefered to determine A_1 through the data fitting for CaF_2 and BaF_2. For SrF_2, no uv dn/dT data is available, and Robloff's results must be used. However, in the case of MgF_2, $CaCl_2$, $SrCl_2$, and $BaCl_2$, such information is not readily available, and no attempt is made to apply the dn/dT formula.

3. NUMERICAL DATA

Reference data are generated through critical evaluation, analysis, and synthesis of the available experimental data. The procedure involves critical evaluation of the validity and accuracy of available data and information, resolution and reconciliation of disagreements in conflicting data, correlation of data in terms of various controlling parameters, curve fitting with theoretical or empirical equations, comparison of resulting values with theoretical predictions or with results derived from semi-theoretical relationships. Physical optical principles and semi-empirical techniques are employed to fill gaps and to extrapolate existing data so that the resulting recommended values are internally consistent and cover as wide a range of each of the controlling parameters as possible. No attempt was made to analyze the thin film data and the regions of strong absorption, because of the scantiness of reliable information. However, experimental data for such regions are also presented along with those for the transparent region in the experimental data tables.

A number of figures and tables summarize the information and give data as a function of wavelength and temperature. The conventions used in this presentation, and specific comments on the interpretation and use of data are given below. Each subsection in this section gives all the information and data for a given material. The subsections are arranged in the following

order:

3.1 Calcium Fluoride, CaF_2

3.2 Strontium Fluoride, SrF_2

3.3 Barium Fluoride, BaF_2

3.4 Magnesium Fluoride, MgF_2

3.5 Calcium Chloride, $CaCl_2$

3.6 Strontium Chloride, $SrCl_2$

3.7 Barium Fluoride, $BaCl_2$

Presented in each subsection are information and data in the following order :

- a text describing the material and discussing the data, analysis, and recommendations,
- a table of recommended (including provisional) values on n, $dn/d\lambda$, and dn/dT,
- a figure of n,
- a figure of $dn/d\lambda$,
- a figure of dn/dT,
- a table of measurement information on n,
- a table of experimental data on n,
- a table of measurement information on dn/dT (if any),
- a table of experimental data on dn/dT (if any),
- a table for comparison of proposed dispersion equations (if any).

In all figures containing experimental data, a data set is denoted by the number assigned in the accompanying tables on the measurement information and experimenta data. When several sets of data are too close to be resolved, some of the data sets, though listed in the table, are omitted from the figure for the sake of clarity.

In the figures for index n and dn/dT, the wavelength is plotted on a logarithmic scale in order to cover a wide wavelength range in a single plot. In the figures for $dn/d\lambda$, both $dn/d\lambda$ and λ are logarithmically plotted. The tables on the measurement information give for each set of data the following information: the reference number, author's name (or names), year of oublication, experimental method used for the measurement, wavelength range covered by the data, temperature range, the description and characterization of the specimen, and information on measurement conditions contained in the original paper. In

these tables the code designations used for the experimental methods for refractive index determinations are as following:

A Abeles method

D Deviation method (prism method)

P Pulfrich or Abbe refractometer

I Interference method

T Transmission method

R Reflection method

M Immersion method

H High fregency modulation method

B Brewster angle method

C Polarization method

S Thickness determination method

L Multilayer method

F Focal length method

The methods listed above are arranged in the order of the inherent accuracy or their popularity. The deviation method is the most popular and accurate means of determining the refractive indices to the fifth decimal place or better. The Pulfrich refractometer and interference technique can be used up to the fourth decimal place. Transmission, reflection, and immersion methods yield results good to the third place, while the multilayer and focal length results are no better than two or three places. For a comprehensive yet concise review of all these methods, the reader is referred to the text in [8] and [9].

For some materials, dispersion equations have been proposed in a number of earlier works. In such cases, a table listing a few typical proposed equations is given. All equations are converted to the form of eq (7) whenever possible so as to facilitate a visual comparison. This table is by no means an exhaustive collection; however, it gives the reader a general picture on the evolution of the dispersion formulas used in the calculation of the refractive index.

In the tables of recommended (including provisional) values, the values are presented with step-wise increasing increments in wavelength. The magnitudes of the increments vary with the slope and curvature of the curve to facilitate linear interpolations. The following scheme (in units of micrometer) is uniformly adopted for this presentation.

Wavelength range	Increment
<0.30	0.002
0.30-0.40	0.005
0.40-0.60	0.01
0.60-1.00	0.02
1.00-5.00	0.05
5.00-10.0	0.10
10.00-15.00	0.20
>15.00	0.50

In the tables, values for each property are given to the same number of decimal places in order to show the variation of

the property and for tabular smoothness; this should not be interpreted as indicative of the accuracy of the values. The uncertainties of the tabulated values for the refractive index, $dn/d\lambda$ and dn/dT for each material in different wavelength ranges is given in the discussion pertaining to the material. In connection with this, the tabulated values are classified as "recommended values" or "provisional values". The criteria of the classification depend upon the level of confidence in the values as given below:

Uncertainty range	Classification
For refractive index:	
≤ 0.005	recommended
>0.005	provisional
For dn/dT (in units of 10^{-6} K^{-1}):	
≤ 3.0	recommended
>3.0	provisional

It should be noted that recommendations are made only for the bulk materials at 293 K in the transparent wavelength region.

In general, refractive indices obtained by the deviation method are reported to the fifth or sixth decimal place. However, detailed compositions and characterizations of the specimens are usually not clearly given. Since impurities in the sample and conditions of the surfaces are decisive factors affecting the observed results, such highly precise data can not be applied to a sample chosen at random. For this reason we do

not attempt to recommend any particular set of data with the reported high accuracy, but to generate the most probable values for the pure crystals. As a result, the estimated uncertainties for the recommended values on the refractive index are higher than those for the reported data obtained by high-precision measurements. In this work, the highest estimated accuracy of the refractive index is to the fourth decimal place.

3.1 Calcium Fluoride, CaF_2

Calcium fluoride, one of the fluorite-type crystals, is of considerable interest from the experimental and theoretical point of view. The compound is ionic but, in contrast to binary NaCl-type crystals, it has a number of structural features associated primarily with the presence of two equivalent F^- ions in a unit fluorite cell.

Rather pure single crystal calcium fluoride is found in nature and is called " Fluorite " or " Fluorspar ". Calcium fluoride of similar purity, but of larger dimensions, has been produced by controlled freezing of purified molten calcium fluoride after an initial scavenging with lead fluoride. Fluorspar is widely used in iron foundry operations, the manufacture of primary aluminum and magnesium, as source of fluorine chemicals, for the production of glass and enamels, and innumerable other uses.

Calcium fluoride has been an important optical material used in the design of optical components and systems for many years because it occurs naturally in large sizes and many measurements on the refractive index are available. The crystal is transparent in the region from about 0.15 to 15 micrometers. The transparent region may be divided into three subregions, in each of which CaF_2 has useful applications. From 0.15 up to 0.3 micrometer and from 6.0 up to 15 micrometers the dispersion is

high and the crystal is used for high dispersion devices, in spite of low transmittance at the limits. In the region from 0.3 up to 6.0 micrometers dispersion is low but transmission is high, and it is therefore used as windows and lenses in optical systems.

Among the alkaline earth halides, calcium fluoride is the most used material. One of the reasons is that it is readily available in large sizes. In the present work we have compiled more than thirty data sets. The earliest measurement on the refractive index of CaF_2 was made by Stefan [28] in 1871. Since then, numerous observations were carried out. Among the early active investigators are Rubens [32], Paschen [37] and Martens [41]. As can be anticipated, the early work was performed in the transparent region by the prism method. As a result, refractive indices of CaF_2 in the wavelength region from 0.18 to 9.43 micrometers were already available by the turn of the century. Coblentz [9], in 1920, reduced the measured and computed values of Langley [39], Paschen [39] and Rubens [35] to a common temperature of 293K and after careful analysis adopted a table of refractive index from a smooth curve drawn through these data. This table of refractive index was thought to represent the most accurate and comprehensive values available in the literature. Another table of refractive index was compiled by Kohlrausch [93] in 1940, including data in the ultraviolet region.

It can also be anticipated that refractive indices in the visible region are accurate, while those in the invisib e regions need further verification because of inadequate infrared detecting devices and inaccurate spectral line identification. Most of these data have been referenced and compared and quoted in the literature through the years, but no further measurement in this region was made until 1963, when Malitson [48] performed a systematic measurement of the refractive index for both natural ard synthetic CaF_2 crystals in the spectral region from 0.22 to 9.73 micrometers, using the prism method. He found that the difference in refractive index of the synthetic and natural fluorite is of the order of $3x10^{-5}$. This excellent agreement between samples demonstrates that the artificial crystal, when properly synthesized, should be comparable in refractive properties to good natural fluorite. Compared with values of Coblentz and Kohlrausch, good agreement is observed in the visible region and discrepancies occur in the ultraviolet and infrared as expected.

Experimental measurements on the refractive index of CaF_2 in the transparent region were made for the purpose of optical applications such as optical components and system design, particularly for the ultraviolet and infrared regions. Experimental studies outside the transparent region were performed with different purposes in mind. In the ultraviolet region the main interest is to determine the band structure of the crystal. Because of high absorption in the vacuum

ultraviolet, the optical properties in the short wavelength region can only be derived through the analysis of reflection spectra. Fabre et al. [49] found, through Kramers-Kronig analysis, a strong absorption peak located at 0.112 micrometer which sets the lower wavelength limit of the transparency of CaF_2. Field et al. [52] found, by the oscillator fit method, that the absorption peak nearest to the transparent region is at 0.119 micrometer. The complexity of absorption in the UV region is revealed by further exploration into the UV region with higher photon energy. Ganin et al. [53] studied the optical properties in the energy range 5-20 eV by Kramers-Kronig analysis of the reflection spectrum. In addition to the first absorption peak at 0.112 micrometer, he observed more absorption peaks with intensities comparable to that of the first peak. Further details of the reflection spectrum in the UV region were investigated by Rubloff [24], with photon energy up to 36 eV, at three temperatures as shown in figure 4 and table 7.

In the far infrared region, the purpose of the majority of studies has been to determine precisely the frequencies of the optically active lattice vibrations, and the refractive index at long wavelength. In the absence of absorption, refractive index at long wavelength is approximately the square root of the static dielectric constant. Berman et al. [50] investigated the region from 294 to 580 micrometer using the reflection and transmission method. The resulted refractive indices in the region from 290 to 580 show no dispersion within the limits of experimental error

and the averaged value of refractive index, 2.58, is in agreement with that calculated from the static dielectric constant. However, dispersion in n occurs in the region from 110 to 280 micrometer. Kaiser et al. [17] studied the reflection spectrum in the restrahlen region from 10 to 40 micrometer. Two absorption peaks were deduced from the reflection spectrum by the Lorentz oscillator theory. The stronger one, at 38.9 micrometer, was identified as the optical active TO resonance and the other one, about one order of magnitude weaker, is at 30.5. The origin of this weaker absorption was unknown and Kaiser proposed the possibility of a two-phonon combination band involving the TO mode. However, this weak absorption does not appear in Lowndes' work [15] in which the reflection spectrum was studied by Kramers-Kronig analysis. Since Lowndes may have used a purer sample than that used by Kaiser, it is likely that the weaker absorption at 30.5 micrometer is due to impurity contents of the sample.

On the basis of our review of available data, data sets measured by Malitson [48], Martens [41] and Paschen [40] were selected as the basis for reference data generation because of the consistency of their results. Malitson used the Sellmeier formula to mathematically fit his experimental data. The resulting Sellmeier formula is listed in table 17, where dispersion equations proposed by various investigators are listed together to facilitate a visual comparison. The optical dielectric constant calculated from his equation is 2.04, which

is in agreement with those obtained from other dispersion equations. However, the static dielectric constant based on his equation is 5.887, subtantially lower than the experimental value, 6.81. This large discrepancy is mainly due to a low value of the infrared absorption wavelength used in his equation. The dispersion equation obtained by Martens included three terms due to infrared absorption and yielded a value of 6.92 for the static dielectric constant. He used as wavelengths of the three absorption bands 24.0, 31.6, and 40.53 micrometers. The second corresponds to that reported by Kaiser et al. and the third and first correspond to the TO and LO mode phonons respectively. Although these wavelengths are somewhat longer than the corresponding but more reliable values now available, it is indeed a surprising that Martens could make a prediction based on the then available refractive index data in a limited wavelength range.

To account for the ultraviolet absorption effects, Malitson used two terms, the one with the longer resonant wavelength representing the total effect of the first few strong absorption peaks and the other representing the effect of the remaining absorption. Martens used a single term and a constant to account for the effect of utraviolet absorptions. The first term represented the total effect of excitations of electrons from the upper valence bands to the lower conduction bands, while the constant represented the total effect of excitations of the outermost core electrons, and interband and ionizating

transitions.

In the present work, we followed Marten's treatment for uv contributions and used the available wavelengths of optical phonons for the infrared terms in the dispersion equation. More precisely, the equation consists of a constant, one term from uv contributions and two terms from infrared contributions. The following two values were chosen as the wavelengths of optical phonons:

λ_{LO} =21.18 micrometers (average of two entries in table 6),

λ_{TO} =38.46 micrometers (average of three entries in table 6)

The calculation yielded the following dispersion equation for CaF_2 at 293 K in the transparent region, 0.15 - 12.0 micrometers:

$$n^2 = 1.33973 + \frac{0.69913\,\lambda^2}{\lambda^2 - (0.09374)^2} + \frac{0.11994\,\lambda^2}{\lambda^2 - (21.18)^2} + \frac{4.35181\,\lambda^2}{\lambda^2 - (38.46)^2}, \qquad (15)$$

where λ is in units of micrometer.

This dispersion equation closely fits Malitson's values, with a root mean square residual of 2.4×10^{-5} in the spectral region from 0.22 to about 10.0 micrometers. However, in extending the use of the equation beyond this region care must be exercised because of the uncertain accuracy with which it represents effects of the nearby absorption bands. In the infrared region, beyond 10.0 micrometers, this equation would be expected to be valid up to 12 micrometers, because absorption bands in far infrared regions have little effect on the refractive index in the transparent region. In the ultraviolet

region the situation is different. The effective wavelength, λ_u, can be used in representing the total effect of a number of absorption bands on the refractive index in the transparent region far enough from the first exciton peak at 0.112 micrometer, but in the spectral range from 0.15 to 0.22 micrometer errors may arise from errors in the values of λ_u, which was determined by fitting the available data at wavelengths longer than 0.22 micrometers. An estimate of an upper limit on the uncertainties can be evaluated by the following equation, obtained by differentiating eq (15) with respect to λ_u:

$$\Delta n = \frac{0.69913\,\lambda^2}{(\lambda^2 - \lambda_u^2)^2}\left(\frac{\lambda_u \Delta\lambda_u}{n}\right), \qquad (16)$$

where $\Delta\lambda_u = 0.112 - \lambda_u$.

The optical dielectric constant obtained from eq (15) is 2.03866, in good agreement with that from other work. The static dielectric constant implied by this equation is 6.511, about 0.3 less than Andeen's value (see table 5). This discrepancy is no larger than is to be expected, since there are still many resonant far infrared absorptions, not accounted for by eq (15), which make small contributions to the static dielectric constant. The Sellmeier formula is at best an approximation describing the observed data in the transparent region by neglecting the damping factors in the dispersion equation. Ignoring the damping factors effectively reduces the magnitude of the coefficients of the corresponding terms, and leads to a smaller value of the static

dielectric constant.

In addition to the room temperature refractive index, dn/dT data is needed for evaluation of n at other temperatures. Among the alkaline earth halides, calcium fluoride is the only material for which dn/dT has been frequently investigated. The resulting data are given in figure 10 and table 13. It is clear from figure 10 that discrepancies between investigators are quite appreciable at wavelengths longer than that of visible light. However, the magnitude of the discrepancies is in the order of 1 to 2×10^{-6} K^{-1}, and they may be due to uncertainties in the determination of refractive indices, because the temperature intervals used in these experiments are in general less than 100 degrees; thus discrepancies of a few units in the fifth decimal place or of one unit in the fourth place of the refractive indices will give noticeable discrepancies in dn/dT. It can be seen from figure 10 that the discrepancies become noticeable in the region beyond about one micrometer in the infrared. Experimental errors in measuring refractive indices are likely to be large in this region because no photographic method can be used. However, among the available data, those reported by Lipson et al. [59], by Harris et al. [60] and by Tsay et al. [92] were obtained by using an interferencee method in which dn/T was determined directly by observing the changes in the number of fringes in a given temperature interval. This method is believed to be the most accurate method for the determination of dn/dT, but data obtained by this method are available only at five

spectral lines, of wavelengths 0.325, 0.4416, 0.6328, 1.15 and 3.39 micrometers.

With the existing data we have no alternative but to use the data of Michell [56], Liebreich [57, 58] and Malitson [48] at wavelengths shorter than 0.8 micrometer in the determination of the coefficients of the constant and ultraviolet terms, neglecting the infrared terms. This approximation is valid because a simple calculation will show that the effect of the infrared terms on dn/dT in the wavelength range mentioned is less than 0.1, while the magnitude of dn/dT is about 10. Then, by using the data of Lipson et al. [59] and of Tsay et al. [92] in the calculation of the coefficients of the infrared terms, we found the equation given below, which closely fits the selected data:

$$2n\frac{dn}{dT} = -16.6 - 57.3(n^2 - 1) + \frac{44.9\,\lambda^4}{[\lambda^2 - (0.09374)^2]^2} + \frac{151.54\,\lambda^2}{\lambda^2 - (38.46)^2} + \\ + \frac{1654.6\,\lambda^4}{[\lambda^2 - (38.46)^2]^2} \qquad (17)$$

Data on the temperature dependence of dn/dT have been obtained for five spectral lines by Houston et al. [47], Selezneva [64], Lipson et al. [59] and Tsay et al. [92]. The measurement information and results of their work are given in tables 15 and 16 and are plotted in figure 11. A general trend revealed by the available data is that in the vicinity of room temperature the magnitude of dn/dT increases slightly with

temperature. Although available data on dn/dT versus temperature are limited to a few particular wavelengths, the same trend is likely to hold at other wavelengths. A similar effect was noted by Malitson [48]. The possible origin of this increase was discussed by Lipson et al. and Tsay et al., with the conclusion that the dn/dT of CaF_2 exhibits a variation with temperature comparable to that of the thermal expansion coefficient. However, the relation between the variation of dn/dT with temperature and the change of the thermal expansion coefficient has not yet been established for general applications because it varies very much with wavelength. For the time being the application of eq (4) to evaluate dn/dT at temperatures not far from 293K is recommended.

Equations (15) and (17) were used to generate the reference data given in the table of recommended values. The values of $dn/d\lambda$ were simply evaluated by the first derivative of eq (15). Although the values of n are given to the fifth decimal place and those of dn/dT to the first, this does not reflect the accuracy and reliability of the results; they are so given simply for smoothness of tabulation. For the proper use of the tabulated values the reader should follow he criteria given below.

For refractive index:

Wavelength range micrometer	Estimated uncertainty, ±
0.15-0.20	0.005

0.20-0.30	0.0005
0.30-0.40	0.0002
0.40-9.0	0.0001
9.0-10.0	0.0005
10.0-12.0	0.005

For dn/dT:

0.15-0.20	3.0
0.20-0.30	2.0
0.30-1.00	1.0
1.0-6.0	1.5
6.0-10.0	2.0
10.0-12.0	3.0

TABLE 8. RECOMMENDED VALUES ON THE REFRACTIVE INDEX AND ITS WAVELENGTH AND TEMPERATURE DERIVATIVES FOR CALCIUM FLUORIDE AT 293K*

λ μm	n	-dn/dλ μm^{-1}	dn/dT $10^{-6} K^{-1}$	λ μm	n	-dn/dλ μm^{-1}	dn/dT $10^{-6} K^{-1}$	λ μm	n	-dn/dλ μm^{-1}	dn/dT $10^{-6} K^{-1}$
0.150	1.57696	3.10791	6.1	0.270	1.46097	0.27640	-8.1	0.700	1.43180	0.01454	-10.6
0.152	1.57095	2.90030	5.2	0.272	1.46043	0.26974	-8.1	0.720	1.43152	0.01351	-10.6
0.154	1.56534	2.71219	4.3	0.274	1.45990	0.26300	-8.2	0.740	1.43126	0.01260	-10.6
0.156	1.56009	2.54122	3.6	0.276	1.45938	0.25645	-8.2	0.760	1.43102	0.01179	-10.6
0.158	1.55517	2.38540	2.9	0.278	1.45887	0.25013	-8.3	0.780	1.43079	0.01107	-10.6
0.160	1.55054	2.24299	2.3	0.280	1.45838	0.24401	-8.3	0.800	1.43057	0.01042	-10.7
0.162	1.54619	2.11252	1.7	0.282	1.45789	0.23811	-8.4	0.820	1.43037	0.00984	-10.7
0.164	1.54208	1.99268	1.1	0.284	1.45742	0.23240	-8.4	0.840	1.43018	0.00932	-10.7
0.166	1.53821	1.88239	0.6	0.286	1.45696	0.22687	-8.4	0.860	1.43000	0.00885	-10.7
0.168	1.53455	1.78062	0.1	0.288	1.45652	0.22153	-8.5	0.880	1.42982	0.00843	-10.7
0.170	1.53108	1.68657	-0.3	0.290	1.45608	0.21636	-8.5	0.900	1.42966	0.00805	-10.7
0.172	1.52780	1.59947	-0.7	0.292	1.45565	0.21135	-8.6	0.920	1.42950	0.00770	-10.7
0.174	1.52468	1.51865	-1.1	0.294	1.45523	0.20650	-8.6	0.940	1.42935	0.00739	-10.7
0.176	1.52172	1.44354	-1.5	0.296	1.45482	0.20180	-8.6	0.960	1.42921	0.00711	-10.7
0.178	1.51890	1.37362	-1.8	0.298	1.45442	0.19725	-8.7	0.980	1.42907	0.00686	-10.7
0.180	1.51622	1.30842	-2.1	0.300	1.45403	0.19284	-8.7	1.000	1.42893	0.00663	-10.7
0.182	1.51367	1.24754	-2.4	0.305	1.45310	0.18239	-8.8	1.050	1.42861	0.00614	-10.8
0.184	1.51123	1.19061	-2.7	0.310	1.45221	0.17271	-8.9	1.100	1.42832	0.00576	-10.8
0.186	1.50890	1.13730	-3.0	0.315	1.45137	0.16372	-8.9	1.150	1.42804	0.00546	-10.8
0.188	1.50668	1.08731	-3.3	0.320	1.45057	0.15536	-9.0	1.200	1.42777	0.00522	-10.8
0.190	1.50455	1.04038	-3.5	0.325	1.44981	0.14757	-9.1	1.250	1.42751	0.00505	-10.8
0.192	1.50251	0.99626	-3.7	0.330	1.44909	0.14032	-9.1	1.300	1.42726	0.00491	-10.8
0.194	1.50056	0.95475	-4.0	0.335	1.44841	0.13354	-9.2	1.350	1.42702	0.00481	-10.8
0.196	1.49869	0.91563	-4.2	0.340	1.44776	0.12721	-9.3	1.400	1.42678	0.00474	-10.8
0.198	1.49690	0.87875	-4.4	0.345	1.44714	0.12128	-9.3	1.450	1.42655	0.00470	-10.8
0.200	1.49518	0.84392	-4.6	0.350	1.44654	0.11573	-9.4	1.500	1.42631	0.00467	-10.8
0.202	1.49352	0.81101	-4.8	0.355	1.44598	0.11052	-9.4	1.550	1.42608	0.00467	-10.8
0.204	1.49193	0.77987	-4.9	0.360	1.44544	0.10563	-9.5	1.600	1.42585	0.00468	-10.8
0.206	1.49040	0.75039	-5.1	0.365	1.44492	0.10103	-9.5	1.650	1.42561	0.00470	-10.8
0.208	1.48893	0.72246	-5.2	0.370	1.44443	0.09670	-9.6	1.700	1.42538	0.00473	-10.8
0.210	1.48751	0.69596	-5.4	0.375	1.44396	0.09263	-9.6	1.750	1.42514	0.00477	-10.8
0.212	1.48614	0.67081	-5.5	0.380	1.44350	0.08878	-9.6	1.800	1.42490	0.00482	-10.8
0.214	1.48483	0.64691	-5.7	0.385	1.44307	0.08516	-9.7	1.850	1.42466	0.00488	-10.8
0.216	1.48356	0.62419	-5.9	0.390	1.44265	0.08173	-9.7	1.900	1.42441	0.00494	-10.8
0.218	1.48233	0.60258	-6.0	0.395	1.44225	0.07849	-9.7	1.950	1.42416	0.00501	-10.8
0.220	1.48114	0.58199	-6.1	0.400	1.44186	0.07543	-9.8	2.000	1.42391	0.00508	-10.8
0.222	1.48000	0.56238	-6.2	0.410	1.44114	0.06978	-9.8	2.050	1.42365	0.00516	-10.8
0.224	1.47889	0.54368	-6.3	0.420	1.44047	0.06469	-9.9	2.100	1.42339	0.00524	-10.8
0.226	1.47783	0.52583	-6.4	0.430	1.43984	0.06011	-9.9	2.150	1.42313	0.00532	-10.8
0.228	1.47679	0.50880	-6.5	0.440	1.43926	0.05597	-10.0	2.200	1.42286	0.00541	-10.8
0.230	1.47579	0.49252	-6.6	0.450	1.43872	0.05221	-10.0	2.250	1.42259	0.00550	-10.8
0.232	1.47482	0.47696	-6.7	0.460	1.43822	0.04880	-10.1	2.300	1.42231	0.00559	-10.8
0.234	1.47388	0.46208	-6.8	0.470	1.43775	0.04569	-10.1	2.350	1.42203	0.00569	-10.8
0.236	1.47297	0.44783	-6.9	0.480	1.43730	0.04285	-10.1	2.400	1.42174	0.00579	-10.8
0.238	1.47209	0.43419	-7.0	0.490	1.43689	0.04025	-10.2	2.450	1.42145	0.00588	-10.8
0.240	1.47123	0.42112	-7.1	0.500	1.43650	0.03787	-10.2	2.500	1.42116	0.00598	-10.8
0.242	1.47040	0.40860	-7.2	0.510	1.43613	0.03568	-10.2	2.550	1.42085	0.00608	-10.8
0.244	1.46960	0.39658	-7.2	0.520	1.43578	0.03367	-10.3	2.600	1.42055	0.00619	-10.8
0.246	1.46882	0.38505	-7.3	0.530	1.43546	0.03182	-10.3	2.650	1.42024	0.00629	-10.8
0.248	1.46806	0.37398	-7.4	0.540	1.43515	0.03011	-10.3	2.700	1.41992	0.00640	-10.7
0.250	1.46732	0.36335	-7.5	0.550	1.43485	0.02853	-10.3	2.750	1.41960	0.00650	-10.7
0.252	1.46661	0.35313	-7.5	0.560	1.43458	0.02706	-10.4	2.800	1.41927	0.00661	-10.7
0.254	1.46591	0.34330	-7.6	0.570	1.43431	0.02571	-10.4	2.850	1.41894	0.00672	-10.7
0.256	1.46523	0.33386	-7.7	0.580	1.43406	0.02445	-10.4	2.900	1.41860	0.00683	-10.7
0.258	1.46457	0.32478	-7.7	0.590	1.43382	0.02328	-10.4	2.950	1.41825	0.00694	-10.7
0.260	1.46393	0.31604	-7.8	0.600	1.43360	0.02219	-10.4	3.000	1.41790	0.00705	-10.7
0.262	1.46331	0.30764	-7.8	0.620	1.43317	0.02023	-10.5	3.050	1.41755	0.00716	-10.7
0.264	1.46270	0.29954	-7.9	0.640	1.43278	0.01852	-10.5	3.100	1.41719	0.00728	-10.7
0.266	1.46211	0.29173	-8.0	0.660	1.43243	0.01702	-10.5	3.150	1.41682	0.00739	-10.7
0.268	1.46154	0.28420	-8.0	0.680	1.43210	0.01570	-10.5	3.200	1.41645	0.00750	-10.7

TABLE 8. RECOMMENDED VALUES ON THE REFRACTIVE INDEX AND ITS WAVELENGTH AND TEMPERATURE DERIVATIVES FOR CALCIUM FLUORIDE AT 293K (CONTINUED)*

λ μm	n	-dn/dλ μm^{-1}	dn/dT 10^{-6} K^{-1}	λ μm	n	-dn/dλ μm^{-1}	dn/dT 10^{-6} K^{-1}	λ μm	n	-dn/dλ μm^{-1}	dn/dT 10^{-6} K^{-1}
3.250	1.41607	0.00762	-10.7	4.850	1.40077	0.01159	-10.3	7.900	1.35199	0.02046	-8.4
3.300	1.41564	0.00774	-10.7	4.900	1.40019	0.01172	-10.3	8.000	1.34989	0.02121	-8.2
3.350	1.41520	0.00785	-10.7	4.950	1.39960	0.01185	-10.3	8.100	1.34775	0.02157	-8.1
3.400	1.41498	0.00797	-10.6	5.000	1.39900	0.01199	-10.2	8.200	1.34557	0.02194	-8.0
3.450	1.41450	0.00809	-10.6	5.100	1.39779	0.01225	-10.2	8.300	1.34336	0.02231	-7.9
3.500	1.41409	0.00820	-10.6	5.200	1.39655	0.01253	-10.2	8.400	1.34111	0.02269	-7.8
3.550	1.41368	0.00832	-10.6	5.300	1.39529	0.01280	-10.1	8.500	1.33882	0.02307	-7.7
3.600	1.41326	0.00844	-10.6	5.400	1.39399	0.01307	-10.1	8.600	1.33649	0.02345	-7.5
3.650	1.41283	0.00856	-10.6	5.500	1.39267	0.01335	-10.0	8.700	1.33413	0.02384	-7.4
3.700	1.41240	0.00868	-10.6	5.600	1.39132	0.01363	-10.0	8.800	1.33173	0.02424	-7.3
3.750	1.41197	0.00880	-10.6	5.700	1.38995	0.01391	-9.9	8.900	1.32928	0.02464	-7.1
3.800	1.41152	0.00893	-10.6	5.800	1.38854	0.01420	-9.9	9.000	1.32680	0.02504	-7.0
3.850	1.41107	0.00905	-10.6	5.900	1.38711	0.01449	-9.8	9.100	1.32427	0.02546	-6.8
3.900	1.41062	0.00917	-10.5	6.000	1.38564	0.01477	-9.8	9.200	1.32171	0.02587	-6.7
3.950	1.41016	0.00929	-10.5	6.100	1.38415	0.01506	-9.7	9.300	1.31910	0.02630	-6.5
4.000	1.40969	0.00942	-10.5	6.200	1.38263	0.01536	-9.7	9.400	1.31645	0.02673	-6.3
4.050	1.40921	0.00954	-10.5	6.300	1.38108	0.01566	-9.6	9.500	1.31375	0.02715	-6.1
4.100	1.40873	0.00966	-10.5	6.400	1.37950	0.01596	-9.6	9.600	1.31101	0.02761	-6.0
4.150	1.40825	0.00979	-10.5	6.500	1.37789	0.01626	-9.5	9.700	1.30823	0.02806	-5.8
4.200	1.40776	0.00991	-10.5	6.600	1.37625	0.01657	-9.4	9.800	1.30540	0.02852	-5.6
4.250	1.40726	0.01004	-10.5	6.700	1.37458	0.01688	-9.4	9.900	1.30253	0.02898	-5.4
4.300	1.40675	0.01017	-10.5	6.800	1.37287	0.01719	-9.3	10.000	1.29961	0.02945	-5.2
4.350	1.40624	0.01029	-10.4	6.900	1.37114	0.01750	-9.2	10.200	1.29362	0.03042	-4.7
4.400	1.40572	0.01042	-10.4	7.000	1.36937	0.01782	-9.2	10.400	1.28744	0.03142	-4.3
4.450	1.40520	0.01055	-10.4	7.100	1.36757	0.01815	-9.1	10.600	1.28105	0.03245	-3.8
4.500	1.40467	0.01068	-10.4	7.200	1.36574	0.01847	-9.0	10.800	1.27445	0.03352	-3.3
4.550	1.40413	0.01080	-10.4	7.300	1.36388	0.01880	-8.9	11.000	1.26764	0.03464	-2.7
4.600	1.40359	0.01093	-10.4	7.400	1.36198	0.01913	-8.8	11.200	1.26060	0.03579	-2.1
4.650	1.40304	0.01106	-10.4	7.500	1.36005	0.01947	-8.7	11.400	1.25332	0.03699	-1.5
4.700	1.40248	0.01119	-10.3	7.600	1.35809	0.01981	-8.7	11.600	1.24580	0.03823	-0.8
4.750	1.40192	0.01132	-10.3	7.700	1.35609	0.02016	-8.6	11.800	1.23802	0.03953	-0.0
4.800	1.40135	0.01146	-10.3	7.800	1.35406	0.02050	-8.5	12.000	1.22998	0.04089	0.7

* IN THIS TABLE MORE DECIMAL PLACES ARE REPORTED THAN WARRANTED MERELY FOR THE PURPOSE OF TABULAR SMOOTHNESS AND INTERNAL COMPARISON. FOR UNCERTAINTIES OF TABULATED VALUES IN VARIOUS WAVELENGTH RANGES, SEE THE TEXT OF SUBSECTION 3.1.

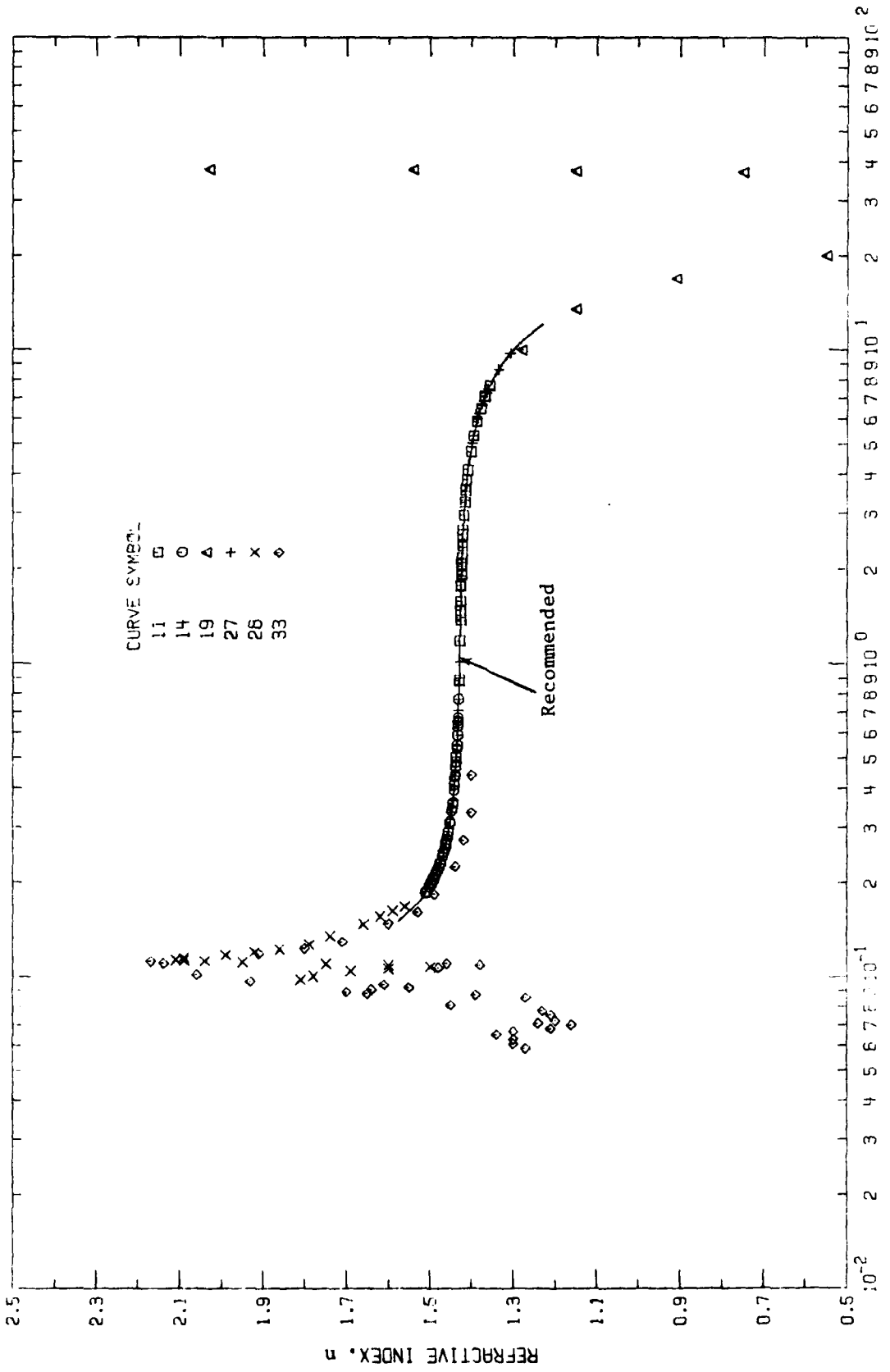


FIGURE 7. REFRACTIVE INDEX OF CALCIUM FLUORIDE (WAVELENGTH DEPENDENCE).

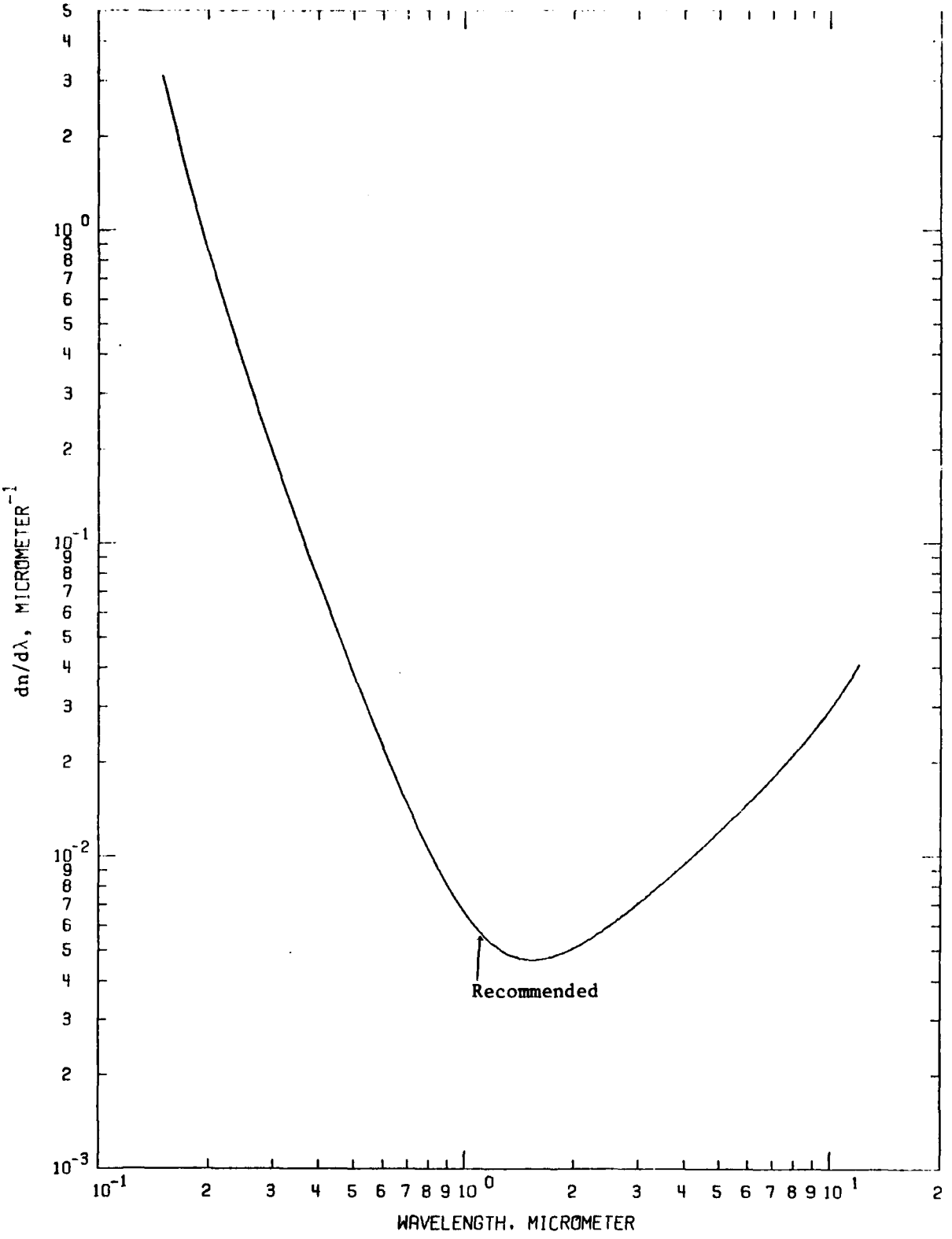


FIGURE 8. WAVELENGTH DERIVATIVE OF REFRACTIVE INDEX OF CALCIUM FLUORIDE.

TABLE 9. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF CALCIUM FLUORIDE (WAVELENGTH DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	28	STEFAN,J.M.	1871	D	0.39-1.69	294	NATURAL CRYSTAL; PRISMATIC SPECIMEN; NEAR 44 DEGREE APEX ANGLE; REFRACTIVE INDEX DETERMINED BY DEVIATION METHOD FOR 5 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE.
2	29	SARASIN,M.E.	1883	D	0.18-0.76	293	NATURAL CRYSTAL; PRISMATIC SPECIMEN; NEAR 60 DEGREE APEX ANGLE; REFRACTIVE INDEX DETERMINED BY DEVIATION METHOD FOR 24 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
3	30	PULFRICH,C.	1892	P	0.589	290	NATURAL CRYSTAL; PRISMATIC SPECIMEN; NEAR 25.5 DEGREE APEX ANGLE; REFRACTIVE INDEX DETERMINED BY AN ABBE AUTO COLLIMATION METHOD FOR THE MEAN OF SODIUM D LINES; DATA EXTRACTED FROM A TABLE.
4	31	RUBENS,H. SNOW,E.W.	1892	D	0.43-8.87	291	NATURAL CRYSTAL; PRISMATIC SPECIMEN; NEAR 60 DEGREE APEX ANGLE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD FOR 25 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE.
5	32	RUBENS,H.	1892	D	0.43-3.33	291	NATURAL CRYSTAL; PRISMATIC SPECIMEN; NEAR 60 DEGREE APEX ANGLE, 5.5 CM EDGE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD FOR 19 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE.
6	33	CARVALLO,M.E.	1893	D	0.63-1.85	293	NATURAL CRYSTAL; PRISMATIC SPECIMEN; NEAR 69 DEGREE APEX ANGLE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD FOR 8 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; TEMPERATURE NOT GIVEN, 293K ASSUMED; A BRIOT FORMULA BEST FIT THE RESULTS ALSO GIVEN.
7	34	SIMON,H.T.	1894	D	0.20-8.77	293	NATURAL CRYSTAL; PRISMATIC SPECIMEN; DIMENSIONS NOT GIVEN; REFRACTIVE INDEX DETERMINED BY DEVIATION METHOD FOR 37 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
8	35	RUBENS,H.	1894	D	1.98-6.48	291	NATURAL CRYSTAL; PRISMATIC SPECIMEN; 60 DEGREE APEX ANGLE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD FOR 18 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE.
9	36	RUBENS,H.	1894	D	6.90-8.95	291	NATURAL CRYSTAL; PRISMATIC SPECIMEN; 60 DEGREE APEX ANGLE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD FOR 10 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE.

TABLE 9. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF CALCIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
10	37	PASCHEN,F.	1894	D	0.88-9.43	291	NATURAL CRYSTAL; PRISMATIC SPECIMEN; NEAR 60 DEGREE APEX ANGLE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD FOR 34 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; TEMPERATURE UNCONTROLLED BUT WITHIN THE RANGE 290-293K; A BRIOT FORMULA BEST FIT THE RESULTS ALSO GIVEN.
11	38	PASCHEN,F.	1895	D	0.88-7.66	290	NATURAL CRYSTAL; PRISMATIC SPECIMEN; NEAR 60 DEGREE APEX ANGLE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD FOR 24 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; TEMPERATURE UNCONTROLLED BUT WITHIN THE RANGE 288-291K; A KETTELER FORMULA ALSO GIVEN; THE AUTHOR POINTED OUT THAT THE APEX ANGLE OF THE PRISM IN HIS 1894 WORK MISDETERMINED.
12	39	LANGLEY,S.P.	1900	D	0.76-3.41	293	SINGLE CRYSTAL; PRISMATIC SPECIMEN; NEAR 60 DEGREE APEX ANGLE, 30MMX30MM VIEW SURFACE; REFRACTIVE INDEX DETERMINED BY DEVIATION METHOD; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF INDEX LESS THAN ONE UNIT OF THE FIFTH DECIMAL PLACE.
13	40	PASCHEN,F.	1901	D	0.88-7.07	284	NATURAL CRYSTAL; PRISMATIC SPECIMEN; NEAR 60 DEGREE APEX ANGLE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD FOR 18 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; KETTELER FORMULA ALSO GIVEN.
14	41	MARTENS,F.F.	1901	D	0.18-0.77	291	NATURAL CRYSTAL; PRISMATIC SPECIMEN; NEAR 60 DEGREE APEX ANGLE, 54MM HEIGHT, 54X50MM VIEW SURFACE; REFRACTIVE INDEX DETERMINED BY DEVIATION METHOD FOR 40 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; A SELLMEIRE TYPE DISPERSION EQUATION BEST FIT THE DATA ALSO GIVEN.
15	42	MARTENS,F.F.	1902	D	0.50-0.65	291	NATURAL CRYSTAL; PRISMATIC SPECIMEN; NEAR 60 DEGREE APEX ANGLE; REFRACTIVE INDEX DETERMINED BY DEVIATION METHOD FOR 3 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE.
16	43	PFUND,A.H.	1941	B	0.56	293	CRYSTAL OF UNSPECIFIED TYPE; FRESHLY POLISHED SURFACE; REFRACTIVE INDEX DETERMINED BY MEANS OF BREWSTERIAN ANGLE; DATA EXTRACTED FROM A TABLE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
17	44	RAMADIER-DELBES	1950	I	8.0-15.0	293	SINGLE CRYSTAL; THIN FILM SPECIMEN OF 25-50 MICROMETER ON METALLIC SUBSTRATE; REFRACTIVE INDEX DETERMINED BY INTERFERENCE METHOD FOR 15 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; TEMPERATURE NOT GIVEN, 293K ASSUMED.

TABLE 9. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF CALCIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
18	45	MEISEN, A.	1961	I	0.43, 3.54	293	THIN FILM SPECIMEN OF WEDGE SHAPED; VACUUM DEPOSITED; REFRACTIVE INDEX DETERMINED BY INTERFERENCE METHOD FOR 2 SPECTRAL LINES; DIGITIZED VALUES REPORTED; REPORTED UNCERTAINTY 0.5%; TEMPERATURE NOT GIVEN, 293K ASSUMED; IT WAS FOUND THAT THE THIN FILM VALUES AGREED WITH THOSE OF THE BULK MATERIAL.
19	17	KAISER, W. SPITZER, W.G. KAISER, R.H. HOWARTH, L.E.	1962	R	10.0-80.0	300	SINGLE CRYSTAL; PLATE SPECIMEN; 0.1-5.0MM THICK; HIGHLY POLISHED SURFACES; NEAR NORMAL INCIDENT REFLECTION SPECTRUM OBTAINED; REFRACTIVE INDEX DEDUCED FROM REFLECTION SPECTRUM WITH LORENTZ THEORY; DATA EXTRACTED FROM A SMOOTH CURVE; LORENTZ DAMPED-OSCILLATOR DISPERSION EQUATION ALSO GIVEN.
20	46	HEILMANN, G.	1963	R	15.0-48.0	293	SYNTHETIC CRYSTAL; PLATE SPECIMEN; 70 DEGREE INCIDENT REFLECTION SPECTRUM OBTAINED; REFRACTIVE INDEX DEDUCED FROM REFLECTION SPECTRUM WITH FRESNEL FORMULAE; DATA EXTRACTED FROM A SMOOTH CURVE.
21	47	HOUSTON, T.W. JOHNSON, L.F. KISLIUK, P. WALSH, D.J.	1963	D	0.54-1.85	93	SINGLE CRYSTAL; HIGH PURITY; PRISMATIC SPECIMEN; POLISHED SURFACES FLAT TO 1/2 WAVELENGTH OF 0.535 MICROMETER LINE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD FOR 6 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE.
22	47	HOUSTON, T.W. ET AL.	1963	D	0.54-1.85	298	SIMILAR TO ABOVE BUT FOR 7 LINES AND AT A HIGHER TEMPERATURE.
23	48	MALITSON, I.H.	1963	D	0.40-0.77	288	SYNTHETIC CRYSTAL; GROWN BY THE STOCKBARGER TECHNIQUE; PRISMATIC SPECIMEN; REFRACTIVE INDEX DETERMINED BY DEVIATION METHOD FOR 9 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; ESTIMATED UNCERTAINTY ABOUT 2×10^{-5}; THIS DATA SET WAS OBTAINED AT NBS IN 1944.
24	48	MALITSON, I.H.	1963	D	0.40-0.77	308	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 308K.
25	48	MALITSON, I.H.	1963	D	0.40-0.77	328	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 328K.
26	48	MALITSON, I.H.	1963	D	0.22-9.73	297	SYNTHETIC CRYSTAL; GROWN AT MIT BY D. C. STOCKBARGER; PRISMATIC SPECIMEN; NEAR 70 DEGREE APEX ANGLE, 55MMX73MM VIEW SURFACE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD FOR 46 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; ESTIMATED UNCERTAINTY ABOUT 2.5×10^{-5}. A SELLMEIRE TYPE DISPERSION EQUATION BEST FIT THE DATA ALSO GIVEN.

TABLE 9. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF CALCIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
27	48	MALITSON, I.H.	1963	D	0.22-9.73	297	NATURAL CRYSTAL; PRODUCED IN EUROPE; PRISMATIC SPECIMEN; NEAR 60 DEGREE APEX ANGLE, 50MMX50MM VIEW SURFACE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD FOR 46 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; ESTIMATED UNCERTAINTY ABOUT $2.83X10^{-5}$.
28	49	FABRE, D. ROMAND, J. VODAR, B.	1964	R	0.10-0.17	293	THIN FILM SPECIMEN OF VARYING THICKNESS; VACUUM DEPOSITED; REFRACTIVE INDEX DETERMINED BY REFLECTANCE OF VARYING THICKNESS; DATA EXTRACTED FROM A FIGURE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
29	58	BERMAN, L.V. ZHUKOV, A.G.	1964	I	294-512	300	CRYSTAL OF UNSPECIFIED TYPE; PLATE SPECIMEN; REFRACTIVE INDEX DETERMINED CORRESPONDING TO MAXIMA IN THE INTERFERENCE CURVE OF NORMAL TRANSMITTANCE; DATA EXTRACTED FROM A TABLE.
30	58	BERMAN, L.V. ET AL.	1964	I	314-580	300	CRYSTAL OF UNSPECIFIED TYPE; PLATE SPECIMEN; REFRACTIVE INDEX DETERMINED CORRESPONDING TO MINIMA IN THE INTERFERENCE CURVE OF NORMAL TRANSMITTANCE; DATA EXTRACTED FROM A TABLE.
31	16	BOSOMWORTH, D.R.	1967	I	55-422	80	SINGLE CRYSTAL; IMPURITIES $10-100X10^{-6}$ FE; OBTAINED FROM THE HARSHAW CHEMICAL CO.; PLATE SPECIMEN; 0.3-10MM THICK; REFRACTIVE INDEX DETERMINED BY INTERFERENCE METHOD; DATA EXTRACTED FROM A FIGURE; DISPERSION EQUATION FOR INFRARED ALSO GIVEN.
32	16	BOSOMWORTH, D.R.	1967	I	150-443	300	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 300K.
33	51	HEITMANN, H. KOPPELMANN, G.	1967	L	0.6328	293	SINGLE CRYSTAL; HIGH PURITY; PRODUCTION OF S[illegible]ARDT CO.; VACUUM DEPOSITED; THIN FILM SPECIMEN OF QUA[illegible]R WAVELENGTH ALTERNATE WITH ZNS AND ZNSE FILMS; REFRACTIVE INDEX DETERMINED BY MULTILAYER METHOD FOR 1 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
34	28	EASTMAN KODAK CO.	1971	D	1.00-11.0	293	POLYCRYSTALLINE; KODAK INFRARED OPTICAL MATERIAL IRTRAN 3; DESCRIPTION OF SPECIMEN AND EXPERIMENT NOT GIVEN; TEMPERATURE NOT GIVEN, 293K ASSUMED; DATA EXTRACTED FROM A TABLE COMPUTED BY A GIVEN HERZBERGER DISPERSION EQUATION.
35	52	FIELD, G.R. WILKINSON, G.R.	1973		0.21-5.19	293	THIS EXPERIMENTAL DATA SET WAS OBTAINED BY THE AUTHORS THROUGH A PRIVATE COMMUNICATION ; NO INFORMATION OTHER THAN VALUES WAS GIVEN; DATA EXTRACTED FROM A TABLE; TEMPERATURE NOT GIVEN, 293K ASSUMED; THE AUTHORS, HOWEVER, GAVE THE LOREZTZ DAMPED-OSCILLTOR DISPERSION EQUATION.

TABLE 9. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF CALCIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
36	53	GANIN,V.,SIDORIN,V. KARIN,M.,SIDORIN,K. STAROSTIN,N., STARTSEV,G.	1975	R	0.06-0.25	300	SINGLE CRYSTAL; FRESHLY CLEAVED SPECIMEN; NEAR NORMAL REFLECTION SPECTRUM OBTAINED; REFRACTIVE INDEX DEDUCED FROM REFLECTION SPECTRUM WITH KRAMERS-KRONIG RELATION; DATA EXTRACTED FROM A FIGURE.

TABLE 10. EXPERIMENTAL REFRACTIVE INDEX OF CALCIUM FLUORIDE (WAVELENGTH DEPENDENCE)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n)

λ	n
DATA SET 1	
T = 294.0	
0.397	1.44204
0.431	1.43982
0.486	1.43709
0.589	1.43390
0.687	1.43208
DATA SET 2	
T = 293.0	
0.1856	1.50940
0.1931	1.50205
0.19881	1.49629
0.20243	1.49326
0.20618	1.49041
0.20998	1.48766
0.21441	1.48462
0.21935	1.48150
0.22645	1.47762
0.23125	1.47517
0.25713	1.46476
0.27467	1.45958
0.32525	1.44987
0.34015	1.44775
0.34655	1.44697
0.36090	1.44535
0.39681	1.44214
0.41012	1.44122
0.48607	1.43705
0.58920	1.43394
0.65918	1.43257
0.68671	1.43200
0.71836	1.43158
0.76040	1.43101
DATA SET 3	
T = 290.0	
0.5893	1.4399

λ	n
DATA SET 4	
T = 291.0	
0.434	1.4398
0.485	1.4372
0.589	1.4340
0.656	1.4325
0.807	1.4307
0.850	1.4303
0.896	1.4299
0.950	1.4294
1.009	1.4290
1.076	1.4286
1.152	1.4281
1.240	1.4277
1.345	1.4272
1.466	1.4267
1.613	1.4260
1.792	1.4250
2.019	1.4240
2.303	1.4224
2.699	1.4205
3.225	1.4174
4.035	1.4117
4.62	1.408
5.38	1.403
6.46	1.396
8.07	1.378
DATA SET 5	
T = 291.0	
0.434	1.4399
0.485	1.4372
0.590	1.4340
0.656	1.4325
0.740	1.4312
0.784	1.4308
0.834	1.4304
0.889	1.4300
0.952	1.4295
1.024	1.4289

λ	n
DATA SET 5(CONT.)	
1.110	1.4284
1.212	1.4279
1.332	1.4273
1.480	1.4267
1.666	1.4260
1.902	1.4248
2.221	1.4234
2.663	1.4214
3.332	1.4170
DATA SET 6	
T = 293.0	
0.637	1.43292
0.670	1.43192
0.777	1.43096
0.878	1.42996
1.009	1.42904
1.187	1.42804
1.444	1.42676
1.849	1.42460
DATA SET 7	
T = 293.0	
0.2024	1.49332
0.2061	1.49031
0.2098	1.48735
0.2144	1.48444
0.2239	1.47879
0.2329	1.47432
0.2439	1.46961
0.2474	1.46805
0.2491	1.46748
0.2542	1.46572
0.2580	1.46450
0.2608	1.46373
0.2639	1.46274
0.2677	1.46157
0.2684	1.46150

λ	n
DATA SET 7(CONT.)	
0.2763	1.45927
0.2801	1.45846
0.2818	1.45791
0.2880	1.45653
0.2980	1.45447
0.3072	1.45282
0.3081	1.45265
0.3133	1.45173
0.3252	1.44988
0.3345	1.44868
0.3403	1.44785
0.3466	1.44708
0.3630	1.44547
0.4340	1.43968
0.4678	1.43782
0.4800	1.43724
0.4861	1.43698
0.5086	1.43614
0.5349	1.43536
0.5892	1.43379
0.6563	1.43244
0.768	1.43089
DATA SET 8	
T = 291.0	
1.981	1.4241
2.48	1.4212
2.66	1.4200
2.93	1.4182
3.22	1.4166
3.56	1.4135
3.70	1.4126
3.92	1.4107
4.10	1.4093
4.28	1.4069
4.52	1.4045
4.71	1.4027
4.94	1.4000
5.18	1.3970

λ	n
DATA SET 8(CONT.)	
5.52	1.3931
5.70	1.3918
6.02	1.3860
6.48	1.3798
DATA SET 9	
T = 291.0	
6.90	1.3734
7.14	1.3693
7.36	1.3654
7.64	1.3608
7.86	1.3570
8.13	1.3510
8.34	1.3472
8.56	1.3432
8.73	1.3391
8.95	1.3348
DATA SET 10	
T = 291.0	
0.8840	1.42936
1.1786	1.42799
1.3751	1.42699
1.4733	1.42653
1.5715	1.42607
1.6206	1.42592
1.7680	1.42517
1.9153	1.42438
1.9644	1.42412
2.0626	1.42363
2.1608	1.42317
2.2100	1.42297
2.3573	1.42208
2.5537	1.42092
2.6519	1.42015
2.7502	1.41969
2.9466	1.41823
3.1430	1.41704

λ	n
DATA SET 10(CONT.)	
3.2413	1.41608
3.5359	1.41378
3.8306	1.41122
4.1252	1.40850
4.4199	1.40559
4.7146	1.40244
5.0092	1.39902
5.3039	1.39532
5.5985	1.39145
5.8932	1.38721
6.4825	1.37837
7.0718	1.36806
7.6612	1.35672
8.2505	1.34444
8.8398	1.33079
9.4291	1.31612
DATA SET 11	
T = 290.0	
0.8840	1.42992
1.1786	1.42787
1.3756	1.42690
1.4733	1.42641
1.5715	1.42596
1.7680	1.42507
1.9153	1.42437
1.9644	1.42413
2.0626	1.42359
2.1608	1.42308
2.3573	1.42199
2.5537	1.42088
2.6519	1.42016
2.9466	1.41826
3.2413	1.41612
3.5359	1.41379
3.8306	1.41120
4.1252	1.40855
4.7146	1.40238
5.3036	1.39529

TABLE 10. EXPERIMENTAL REFRACTIVE INDEX OF CALCIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n)

λ	n
DATA SET 11(CONT.)	
5.8932	1.38719
6.4825	1.37819
7.0718	1.36805
7.6612	1.35680
DATA SET 12	
T = 293.0	
0.7604	1.431020
0.7627	1.430996
0.8162	1.430425
0.8227	1.430357
0.8538	1.430072
0.8658	1.429963
0.8992	1.429674
0.9090	1.429601
0.9135	1.429555
0.9232	1.429500
0.9357	1.429398
0.9443	1.429328
0.9759	1.429119
1.0041	1.428922
1.0728	1.428516
1.1240	1.428175
1.1399	1.428138
1.1481	1.428063
1.1833	1.427870
1.2016	1.427768
1.2658	1.427428
1.3306	1.427107
1.4333	1.426616
1.4692	1.426459
1.5734	1.425953
1.6017	1.425812
1.6362	1.425637
2.0000	1.423869
2.0536	1.423595
2.0556	1.423601
2.1172	1.423287
2.1658	1.423035

λ	n
DATA SET 12(CONT.)	
2.2016	1.422851
2.4160	1.421649
2.4496	1.421433
2.2900	1.422328
2.3508	1.422009
2.3946	1.421819
2.4160	1.421625
2.4496	1.421421
2.9575	1.418182
3.0430	1.417569
3.0900	1.417205
3.1340	1.416829
3.2100	1.416356
3.2610	1.415935
3.3000	1.415621
3.4090	1.414827
DATA SET 13	
T = 284.0	
0.8940	1.42989
1.1786	1.42798
1.4733	1.42652
1.5715	1.42605
1.7690	1.42515
2.0626	1.42368
2.1508	1.42317
2.3573	1.42209
2.6519	1.42032
2.9466	1.41835
3.2413	1.41623
3.5359	1.41388
4.1252	1.40858
4.7146	1.40242
5.3039	1.39531
5.8932	1.38721
6.4825	1.37834
7.0718	1.36810

λ	n
DATA SET 14	
T = 291.0	
0.185	1.51024
0.186	1.50930
0.193	1.50150
0.197	1.49755
0.198	1.49643
0.200	1.49547
0.204	1.49190
0.208	1.48907
0.211	1.48705
0.214	1.48480
0.219	1.48167
0.224	1.47911
0.231	1.47533
0.242	1.47025
0.250	1.46732
0.257	1.46490
0.263	1.46302
0.267	1.46175
0.274	1.45976
0.281	1.45806
0.291	1.45586
0.308	1.45257
0.312	1.45187
0.340	1.44774
0.358	1.44560
0.394	1.44231
0.410	1.44112
0.434	1.43960
0.441	1.43920
0.467	1.43787
0.486	1.43706
0.508	1.43619
0.533	1.43535
0.546	1.43497
0.589	1.43385
0.627	1.43302
0.643	1.43271
0.656	1.43251
0.670	1.43228

λ	n
DATA SET 14(CONT.)	
0.768	1.43093
DATA SET 15	
T = 291.0	
0.508	1.43620
0.533	1.43537
0.643	1.43274
DATA SET 16	
T = 293.0	
0.56	1.433
DATA SET 17	
T = 293.0	
8.0	1.349
8.5	1.339
9.0	1.325
9.5	1.311
10.0	1.292
10.5	1.271
11.0	1.253
11.5	1.235
12.0	1.215
12.5	1.195
13.0	1.175
13.5	1.150
14.0	1.124
14.5	1.090
15.0	1.055
DATA SET 18	
T = 293.0	
0.4358	1.440
0.5460	1.434

λ	n
DATA SET 19	
T = 300.0	
10.0	1.28
13.5	1.15
16.9	0.91
20.0	0.55
21.2	0.36
22.1	0.20
23.7	0.16
25.8	0.23
28.0	0.32
30.2	0.35
32.8	0.35
34.8	0.35
36.4	0.47
37.1	0.75
37.4	1.15
37.7	1.54
37.9	2.03
38.1	2.68
38.2	3.38
38.2	4.00
38.2	4.64
38.4	5.39
38.4	6.07
38.4	6.76
38.5	7.34
38.6	8.09
38.6	8.91
38.6	9.64
38.6	10.02
38.8	10.65
38.8	11.19
38.9	11.79
39.2	12.35
39.3	11.86
39.5	11.16
39.6	10.62
39.7	10.09
39.9	9.50
40.1	8.88

λ	n
DATA SET 19(CONT.)	
40.3	8.11
40.7	7.36
41.0	6.69
41.6	5.99
42.2	5.45
43.0	4.98
44.2	4.58
45.5	4.26
47.0	4.01
48.7	3.81
50.9	3.62
53.9	3.39
56.6	3.25
59.3	3.14
62.6	3.06
66.2	3.00
70.8	2.96
73.8	2.90
76.8	2.85
80.0	2.85
DATA SET 20	
T = 293.0	
15.0	1.02
16.0	1.00
17.1	0.93
18.6	0.79
20.0	0.61
21.2	0.38
22.1	0.26
23.1	0.20
25.0	0.20
26.7	0.22
28.2	0.26
30.0	0.33
31.7	0.26
33.6	0.20
35.0	0.27
36.0	0.43

TABLE 10. EXPERIMENTAL REFRACTIVE INDEX OF CALCIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n)

λ	n
DATA SET 20 (CONT.)	
36.5	0.65
37.0	0.96
37.5	1.57
37.7	1.98
37.9	2.51
38.2	3.03
38.4	3.59
38.6	3.97
38.8	4.59
39.0	5.07
39.1	5.23
39.5	5.34
39.7	5.22
40.1	5.01
40.8	4.76
41.7	4.54
42.6	4.37
43.6	4.19
44.9	4.02
46.1	3.86
47.0	3.75
47.9	3.64
DATA SET 21	
T = 93.0	
0.5461	1.4378
0.5890	1.4358
0.8195	1.4324
1.0140	1.4313
1.5166	1.4281
1.8459	1.4266
DATA SET 22	
T = 298.0	
0.5461	1.4352
0.5890	1.4340
0.8195	1.4301
1.0140	1.4291

λ	n
DATA SET 22 (CONT.)	
1.2434	1.4279
1.5166	1.4266
1.8459	1.4247
DATA SET 23	
T = 288.0	
0.404656	1.441573
0.435834	1.439555
0.486132	1.437106
0.546074	1.435023
0.589262	1.433893
0.656279	1.432545
0.667814	1.432356
0.706518	1.431763
0.767858	1.430984
DATA SET 24	
T = 308.0	
0.404656	1.441378
0.435834	1.439354
0.486132	1.436894
0.546074	1.434813
0.589262	1.433683
0.656279	1.432335
0.667814	1.432142
0.706518	1.431553
0.767858	1.430768
DATA SET 25	
T = 328.0	
0.404656	1.441169
0.435834	1.439143
0.486132	1.436680
0.546074	1.434593
0.589262	1.433465
0.656279	1.432114
0.667814	1.431922

λ	n
DATA SET 25 (CONT.)	
0.706518	1.431331
0.767858	1.430546
DATA SET 26	
T = 297.0	
0.228803	1.47633
0.24827	1.46796
0.2537	1.46611
0.26520	1.46232
0.28035	1.45827
0.296728	1.45465
0.334148	1.44851
0.34662	1.44691
0.365015	1.44486
0.404656	1.44148
0.435834	1.43946
0.486132	1.43699
0.546074	1.43491
0.589262	1.43379
0.643847	1.43266
0.656279	1.43244
0.667814	1.43225
0.706518	1.43165
0.767858	1.43086
0.85212	1.43001
0.8944	1.42966
1.01398	1.42877
1.3622	1.42692
1.39506	1.42676
1.52952	1.42616
1.7012	1.42533
1.81307	1.42478
1.97009	1.42404
2.1526	1.42305
2.32542	1.42215
2.4374	1.42147
3.3026	1.41561
3.422	1.41469
3.5070	1.41397

λ	n
3.7067	1.41231
4.258	1.40717
5.01882	1.39874
5.3034	1.39523
6.0140	1.38544
6.238	1.38194
6.63306	1.37565
6.8559	1.37178
7.268	1.36445
7.4644	1.36075
8.662	1.33496
9.724	1.30757
DATA SET 27	
T = 297.0	
0.228803	1.47636
0.24827	1.46798
0.2537	1.46614
0.26520	1.46233
0.28035	1.45829
0.296728	1.45467
0.334148	1.44854
0.34662	1.44694
0.365015	1.44490
0.404656	1.44152
0.435834	1.43949
0.486132	1.43703
0.546074	1.43495
0.589262	1.43343
0.643847	1.43272
0.656279	1.43247
0.667814	1.43227
0.706518	1.43169
0.767858	1.43090
0.85212	1.43006
0.8944	1.42967
1.01398	1.42879
1.3622	1.42699
1.39506	1.42681

λ	n
1.52952	1.42616
1.7012	1.42535
1.81307	1.42487
1.97009	1.42404
2.1526	1.42307
2.32542	1.42216
2.4374	1.42149
3.3026	1.41564
3.422	1.41469
3.5070	1.41400
3.7067	1.41231
4.258	1.40717
5.01882	1.39878
5.3034	1.39523
6.0140	1.38544
6.238	1.38200
6.63306	1.37566
6.8559	1.37188
7.268	1.36450
7.4644	1.36076
8.662	1.33503
9.724	1.30761
DATA SET 28	
T = 293.0	
0.0976	1.81
0.1001	1.78
0.1040	1.69
0.1059	1.60
0.1072	1.50
0.1086	1.60
0.1098	1.75
0.1113	1.95
0.1121	2.04
0.1123	2.09
0.1130	2.11
0.1146	2.09
0.1169	1.99
0.1195	1.92

λ	n
DATA SET 28 (CONT.)	
0.1218	1.86
0.1262	1.79
0.1342	1.74
0.1465	1.66
0.1553	1.62
0.1624	1.59
0.1672	1.56
DATA SET 29	
T = 300.0	
294.0	2.57
340.0	2.55
395.0	2.47
512.0	2.86
DATA SET 30	
T = 300.0	
314.0	2.55
362.0	2.49
453.0	2.55
580.0	2.54
DATA SET 31	
T = 80.0	
55.18	3.16
56.02	3.09
57.04	3.05
58.30	3.06
59.45	3.01
61.12	2.99
62.38	2.96
63.89	2.92
65.83	2.89
67.75	2.88
69.78	2.85
71.94	2.82
74.12	2.78

TABLE 10. EXPERIMENTAL REFRACTIVE INDEX OF CALCIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n)

λ	n
DATA SET 31 (CONT.)	
87.87	2.70
91.59	2.68
97.09	2.67
102.56	2.65
109.05	2.63
116.41	2.62
125.00	2.60
135.31	2.59
147.49	2.58
162.68	2.57
179.85	2.56
204.08	2.54
233.10	2.54
277.08	2.54
346.02	2.57
421.94	2.56
DATA SET 32	
T = 300.0	
150.15	2.63
166.11	2.62
184.16	2.61
209.64	2.60
241.54	2.60
293.28	2.59
348.43	2.58
442.47	2.60
DATA SET 33	
T = 293.0	
0.6328	1.23
DATA SET 34	
T = 293.0	
1.0000	1.4289
1.2500	1.4275
1.5000	1.4263
1.7500	1.4251
2.0000	1.4239
2.2500	1.4226
2.5000	1.4211
2.7500	1.4196
3.0000	1.4179
3.2500	1.4161
3.5000	1.4141
3.7500	1.4120
4.0000	1.4097
4.2500	1.4072
4.5000	1.4047
4.7500	1.4019
5.0000	1.3990
5.2500	1.3959
5.5000	1.3926
5.7500	1.3892
6.0000	1.3856
6.2500	1.3818
6.5000	1.3778
6.7500	1.3737
7.0000	1.3693
7.2500	1.3648
7.5000	1.3600
7.7500	1.3550
8.0000	1.3498
8.2500	1.3445
8.5000	1.3388
8.7500	1.3330
9.0000	1.3269
9.2500	1.3206
9.5000	1.3141
9.7500	1.3073
10.0000	1.3002
11.0000	1.2694
DATA SET 35	
T = 293.0	
0.2138	1.48496
0.2378	1.47215
0.2399	1.47124
0.2699	1.46100
0.2752	1.45954
0.2893	1.45621
0.2967	1.45466
0.3341	1.44852
0.3345	1.44847
0.4046	1.44148
0.4358	1.43949
0.4678	1.43785
0.4799	1.43732
0.5085	1.43620
0.5460	1.43496
0.5875	1.43389
0.6438	1.43272
0.6678	1.43230
0.7065	1.43171
0.7800	1.43090
0.8520	1.43007
0.8943	1.42971
1.0139	1.42884
1.1287	1.42815
1.5295	1.42617
1.8132	1.42484
1.9700	1.42407
2.0580	1.42359
2.3250	1.42216
2.7300	1.41970
3.0030	1.41786
3.2765	1.41584
3.5498	1.41366
3.8226	1.41130
4.0950	1.40876
4.3687	1.40604
4.6425	1.40313
4.9140	1.40002
5.1867	1.39670
DATA SET 36	
T = 300.0	
0.0583	1.27
0.0608	1.30
0.0630	1.30
0.0652	1.34
0.0668	1.30
0.0680	1.21
0.0700	1.16
0.0707	1.24
0.0721	1.20
0.0754	1.21
0.0775	1.23
0.0810	1.45
0.0855	1.27
0.0871	1.39
0.0881	1.65
0.0893	1.70
0.0909	1.64
0.0922	1.55
0.0943	1.61
0.0962	1.93
0.1013	2.06
0.1068	1.48
0.1088	1.38
0.1101	1.46
0.1101	2.14
0.1118	2.17
0.1180	1.91
0.1228	1.80
0.1290	1.71
0.1476	1.60
0.1606	1.53
0.1834	1.49
0.2246	1.44
0.2731	1.42
0.3342	1.40
0.4412	1.40

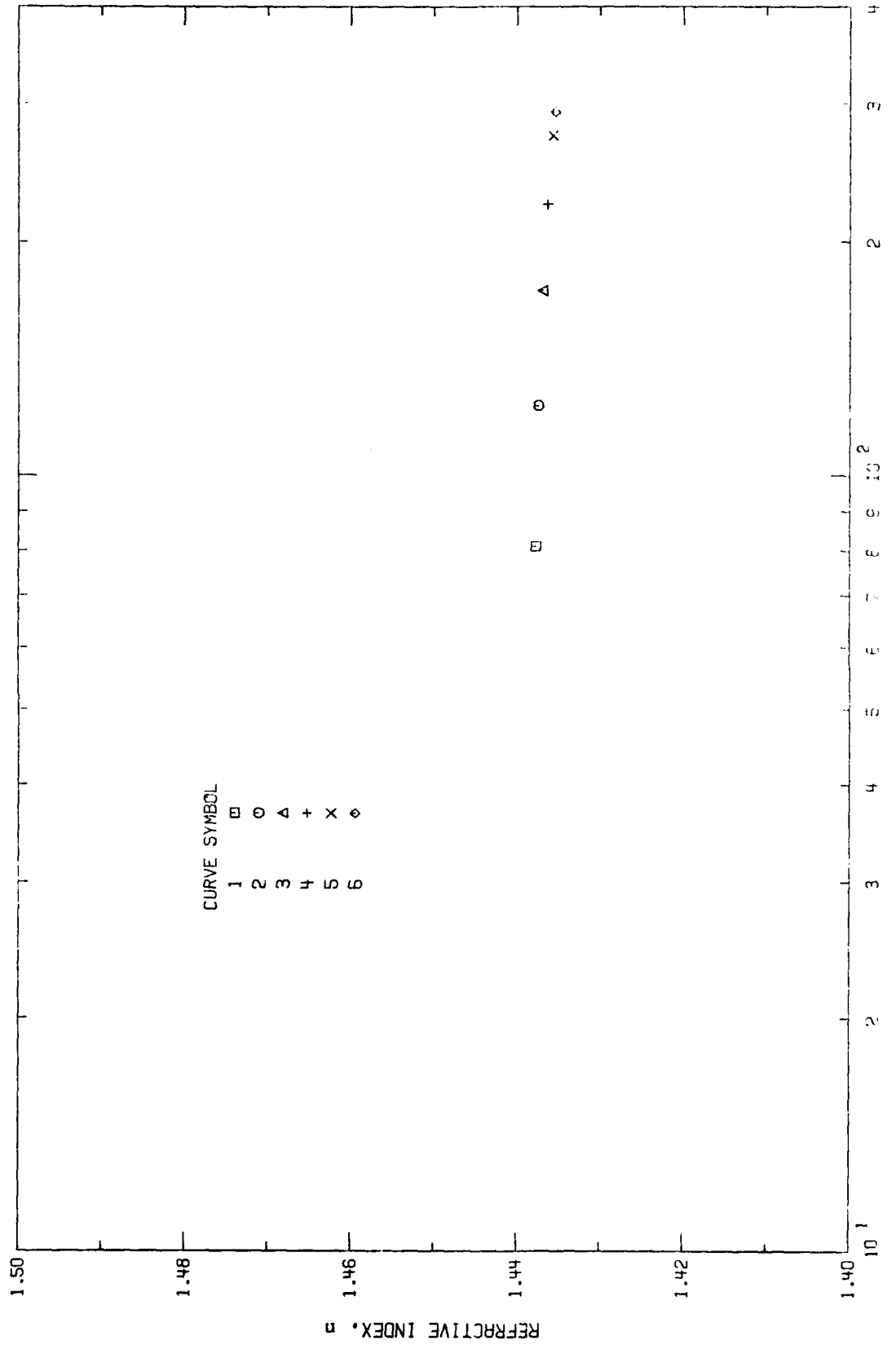


FIGURE 9. REFRACTIVE INDEX OF [illegible] TEMPERATURE DEPENDENCE.

TABLE 11. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF CALCIUM FLUORIDE (TEMPERATURE DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	54	BARBARON, M.	1951	D	0.546	81	SINGLE CRYSTAL; PRISMATIC SPECIMEN; 60 DEGREE APEX ANGLE, 1.2CM HEIGHT; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD FOR THE SPECTRAL LINE 0.546 MICROMETERS; DATA EXTRACTED FROM A TABLE.
2	54	BARBARON, M.	1951	D	0.546	123	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 123K.
3	54	BARBARON, M.	1951	D	0.546	173	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 173K.
4	54	BARBARON, M.	1951	D	0.546	223	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 223K.
5	54	BARBARON, M.	1951	D	0.546	273	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 273K.
6	54	BARBARON, M.	1951	D	0.546	293	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 293K.

TABLE 12. EXPERIMENTAL REFRACTIVE INDEX OF CALCIUM FLUORIDE (TEMPERATURE DEPENDENCE)

[WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n]

T	n
DATA SET 1	
λ = 0.540	
81.6	1.4377
DATA SET 2	
λ = 0.540	
123.6	1.4374
DATA SET 3	
λ = 0.546	
173.(	1.4369
DATA SET 4	
λ = 0.546	
223.6	1.43631
DATA SET 5	
λ = 0.546	
273.0	1.43565
DATA SET 6	
λ = 0.546	
293.6	1.43538

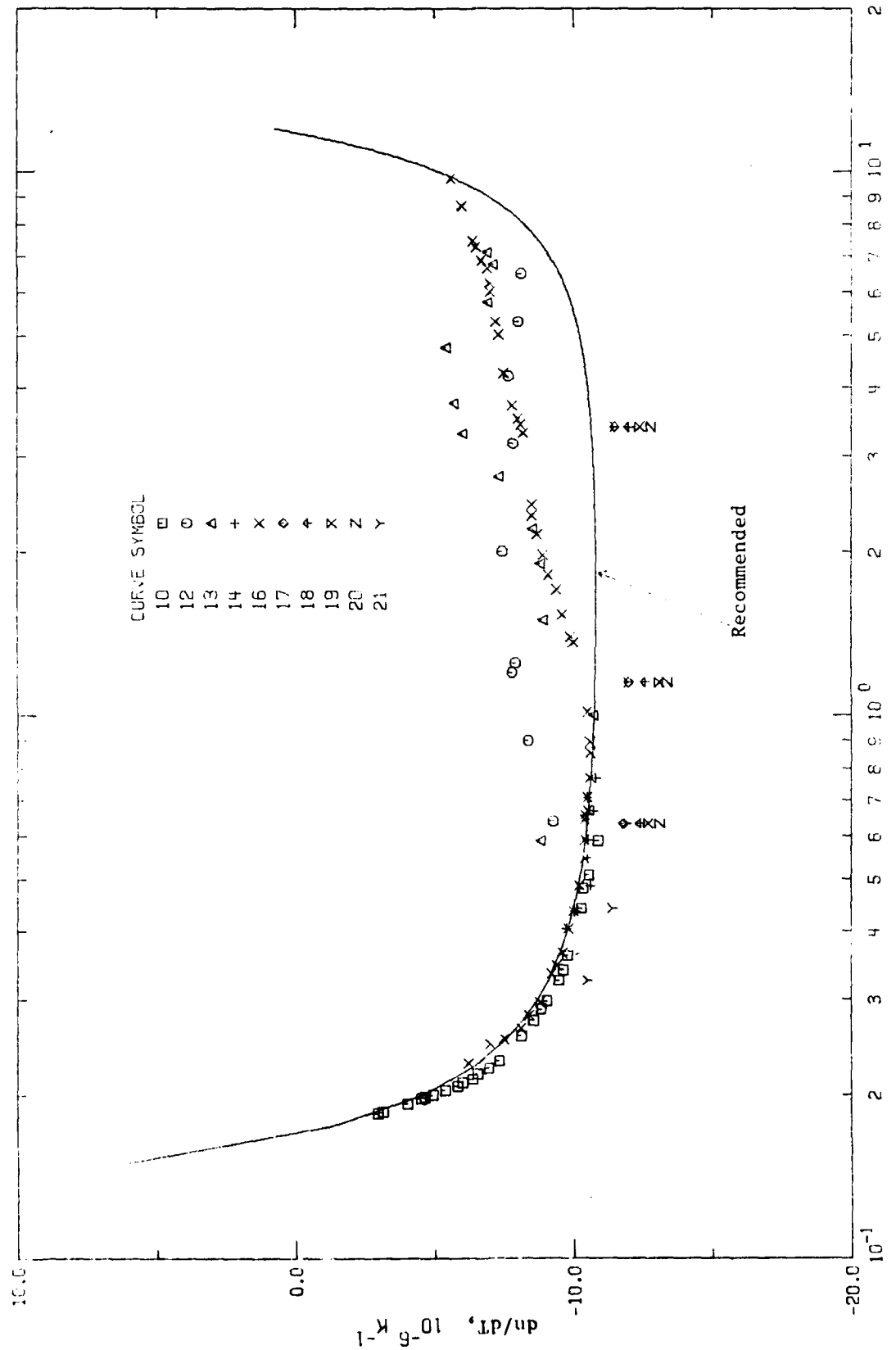


FIGURE 10. TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF CALCIUM FLUORIDE (WAVELENGTH DEPENDENCE).

TABLE 13. MEASUREMENT INFORMATION ON THE TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF CALCIUM FLUORIDE (WAVELENGTH DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	28	STEFAN, J.M.	1871	D	0.39-0.59	330	NATURAL CRYSTAL; PRISMATIC SPECIMEN; NEAR 44 DEGREE APEX ANGLE; DN/DT DETERMINED FOR 3 SPECTRAL LINES USING THE INDICES MEASURED AT 294 AND 366K; DATA EXTRACTED FROM A TABLE.
2	38	PULFRICH, C.	1892	P	0.43-0.66	333	NATURAL CRYSTAL; PRISMATIC SPECIMEN; NEAR 25.5 DEGREE APEX ANGLE; DN/DT DETERMINED FOR 4 SPECTRAL LINES USING THE INDICES MEASURED AT 294 AND 372K; DATA EXTRACTED FROM A TABLE.
3	55	REED, J.O.	1898	P	0.43-0.66	332	NATURAL CRYSTAL; PRISMATIC SPECIMEN; NEAR 29.33 DEGREE APEX ANGLE; DN/DT DETERMINED BY AN ABBE AUTO COLLIMATION METHOD FOR 4 SPECTRAL LINES; ONLY DN/DT REPORTED IN THIS PAPER; DATA EXTRACTED FROM A TABLE.
4	55	REED, J.O.	1898	P	0.43-0.66	340	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 340.1K.
5	55	REED, J.O.	1898	P	0.43-0.66	426	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 426.1K.
6	55	REED, J.O.	1898	P	0.43-0.66	506	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 506.2K.
7	55	REED, J.O.	1898	P	0.43-0.66	551	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 550.7K.
8	55	REED, J.O.	1898	P	0.43-0.66	600	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 599.7K.
9	55	REED, J.O.	1898	P	0.43-0.66	658	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 658.2K.
10	56	MICHELI, E.J.	1902	D	0.18-0.59	334	NATURAL CRYSTAL; PRISMATIC SPECIMEN; NEAR 60 DEGREE APEX ANGLE, 38MMX23MM VIEW SURFACE; REFRACTIVE INDEX DETERMINED BY DEVIATION METHOD; DN/DT DETERMINED FOR 24 SPECTRAL LINES USING THE INDICES MEASURED AT 295 AND 373K; DATA EXTRACTED FROM A TABLE; ONLY DN/DT REPORTED IN THIS PAPER.
11	57	LIEBREICH, E.	1911	D	0.58-6.50	333	NATURAL CRYSTAL; PRISMATIC SPECIMEN; NEAR 29 DEGREE APEX ANGLE, 1.8 CM HEIGHT, 2.0 CM EDGE; REFRACTIVE INDEX DETERMINED BY DEVIATION METHOD; DN/DT DETERMINED FOR 11 SPECTRAL LINES USING THE INDICES MEASURED AT 287 TO 347K; DATA EXTRACTED FROM A TABLE; ONLY DN/DT REPORTED IN THIS PAPER; ESTIMATED UNCERTAINTY ABOUT 14 .
12	57	LIEBREICH, E.	1911	D	0.64-6.50	317	SIMILAR TO ABOVE BUT FOR 9 SPECTRAL LINES AND A DIFFERENT TEMPERATURE INTERVAL.

TABLE 13. MEASUREMENT INFORMATION ON THE TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF CALCIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
13	58	LIEBREICH,E.	1911	D	0.58-7.10	267	NATURAL CRYSTAL; PRISMATIC SPECIMEN; REFRACTIVE INDEX DETERMINED BY DEVIATION METHOD; DN/DT DETERMINED FOR 12 SPECTRAL LINES USING THE INDICES MEASURED AT 241 TO 293K; DATA EXTRACTED FROM A TABLE; ONLY DN/DT REPORTED IN THIS PAPER.
14	48	MALITSON,I.H.	1963	D	0.40-0.77	298	SYNTHETIC CRYSTAL; GROWN BY THE STOCKBARGER TECHNIQUE; PRISMATIC SPECIMEN; REFRACTIVE INDEX DETERMINED BY DEVIATION METHOD; DN/DT DETERMINED FOR 9 SPECTRAL LINES USING THE INDICES MEASURED AT 288 AND 308K; DATA EXTRACTED FROM A TABLE.
15	48	MALITSON,I.H.	1963	D	0.40-0.77	318	SIMILAR TO ABOVE DN/DT DETERMINED FOR 9 SPECTRAL LINES USING THE INDICES MEASURED AT 308 AND 328K.
16	48	MALITSON,I.H.	1963	D	0.22-9.73	292	SYNTHETIC CRYSTAL; GROWN AT MIT BY D. C. STOCKBARGER; PRISMATIC SPECIMEN; NEAR 70 DEGREE APEX ANGLE, 55MMX73MM VIEW SURFACE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD; DN/DT DETERMINED FOR 46 SPECTRAL LINES USING THE INDICES MEASURED AT 287 AND 297K; DATA EXTRACTED FROM A TABLE.
17	59	LIPSON,H.G. TSAY,Y.F. BENDOW,B LIGOR,P.A.	1976	I	0.63-3.39	310	SINGLE CRYSTAL; DISC SPECIMEN; 1.90CM DIAMETER, 1CM TO 2.5CM THICK; DN/DT DETERMINED FOR 3 SPECTRAL LINES BY OBSERVING THE INTERFERENCE FRINGE CHANGES AND THE CORRESPONDING TEMPERATURE CHANGES; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF DN/DT ABOUT $0.6X10^{-6}K^{-1}$.
18	59	LIPSON,H.G. ET AL.	1976	I	0.63-3.39	330	SIMILAR TO ABOVE EXT AT A HIGHER TEMPERATURE OF 330K; UNCERTAINTY OF DN/DT $0.5X10^{-6}K^{-1}$.
19	59	LIPSON,H.G. ET AL.	1976	I	0.63-3.39	350	SIMILAR TO ABOVE EXT AT A HIGHER TEMPERATURE OF 350K; UNCERTAINTY OF DN/DT $0.5X10^{-6}K^{-1}$.
20	60	HARRIS,R.J. JOHNSTON,G.T. KEPPLE,G.A. KROK,P.C.,MUKAI,H.	1977	I	0.63-3.39	318	POLYCRYSTALLINE; OBTAINED FROM THE HARSHAW CHEMICAL CO.; PLATE SPECIMEN; DN/DT DETERMINED DIRECTLY FOR 3 SPECTRAL LINES BY OBSERVING THE FIZEAU INTERFERENCE FRINGE CHANGES AND THE CORRESPONDING TEMPERATURE CHANGES; MEASUREMENTS MADE FROM 298 TO 338K, THE AVERAGED VALUES OF DN/DT WERE GIVEN; DATA EXTRACTED FROM A TABLE.

TABLE 13. MEASUREMENT INFORMATION ON THE TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF CALCIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
21	92	TSAY, Y.F. LIPSON, H.G. LIGOR, P.A.	1977	I	0.32-3.39	310	SINGLE CRYSTAL; DISC SPECIMEN; 1.90CM DIAMETER, 1.27CM THICK; DN/DT DETERMINED BY OBSERVING THE INTERFERENCE FRINGE CHANGES AND THE CORRESPONDING TEMPERATURE CHANGES DATA EXTRACTED FROM A FIGURE; UNCERTAINTY OF DN/DT ABOUT $1.0 \times 10^{-6} K^{-1}$.

TABLE 14. EXPERIMENTAL TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF CALCIUM FLUORIDE (WAVELENGTH DEPENDENCE)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX, dn/dT, 10^{-6} K^{-1})

λ	dn/dT
DATA SET 1	
T = 330.0	
0.397	-12.4
0.486	-12.3
0.589	-12.4
DATA SET 2	
T = 333.0	
0.434	-10.39
0.486	-10.67
0.589	-11.04
0.656	-11.18
DATA SET 3	
T = 332.8	
0.436	-10.57
0.486	-10.67
0.589	-10.92
0.656	-11.11
DATA SET 4	
T = 340.1	
0.436	-10.74
0.486	-10.93
0.589	-11.03
0.656	-11.14
DATA SET 5	
T = 426.1	
0.436	-12.15
0.486	-12.24
0.589	-12.63
0.656	-12.71

λ	dn/dT
DATA SET 6	
T = 506.2	
0.436	-12.67
0.486	-12.81
0.589	-13.18
0.656	-13.32
DATA SET 7	
T = 550.7	
0.436	-13.78
0.486	-13.87
0.589	-14.32
0.656	-14.43
DATA SET 8	
T = 599.7	
0.436	-14.43
0.486	-14.56
0.589	-14.93
0.656	-15.08
DATA SET 9	
T = 656.2	
0.436	-15.21
0.486	-15.35
0.589	-15.84
0.656	-16.04
DATA SET 10	
T = 334.0	
0.185	-2.96
0.186	-3.13
0.193	-4.02
0.197	-4.51
0.198	-4.64
0.200	-4.93
0.204	-5.38

λ	dn/dT
DATA SET 10 (CONT.)	
0.208	-5.82
0.211	-6.01
0.214	-6.37
0.219	-6.55
0.224	-6.96
0.231	-7.32
0.257	-8.11
0.274	-8.55
0.288	-8.84
0.298	-9.04
0.325	-9.48
0.340	-9.64
0.361	-9.79
0.441	-10.28
0.480	-10.35
0.508	-10.56
0.589	-10.89
DATA SET 11	
T = 333.0	
0.589	-11.11
0.64	-11.13
0.9	-10.31
1.2	-10.40
1.25	-10.29
1.3	-10.18
2.0	-9.32
3.16	-8.81
4.2	-8.31
5.3	-8.21
6.5	-7.87
DATA SET 12	
T = 317.0	
0.64	-9.27
0.9	-8.36
1.2	-7.79
1.25	-7.92

λ	dn/dT
DATA SET 12 (CONT.)	
2.0	-7.44
3.16	-7.82
4.2	-7.67
5.3	-8.02
6.5	-8.13
DATA SET 13	
T = 267.0	
0.589	-8.8
1.0	-10.7
1.5	-8.9
1.9	-8.8
2.2	-8.5
2.75	-7.3
3.3	-6.0
3.75	-5.7
4.75	-5.4
5.75	-6.9
6.75	-7.1
7.1	-6.9
DATA SET 14	
T = 298.0	
0.404656	-9.75
0.435834	-10.05
0.486132	-10.60
0.546074	-10.50
0.589262	-10.50
0.656279	-10.50
0.667814	-10.70
0.706518	-10.50
0.767858	-10.80
DATA SET 15	
T = 318.0	
0.404656	-10.12
0.435834	-10.55

λ	dn/dT
DATA SET 15 (CONT.)	
0.486132	-10.70
0.546074	-11.00
0.589262	-10.90
0.656279	-11.05
0.667814	-10.85
0.706518	-11.10
0.767858	-11.10
DATA SET 16	
T = 292.0	
0.228803	-6.2
0.24827	-7.0
0.2537	-7.5
0.26520	-8.1
0.28035	-8.4
0.296728	-8.8
0.334148	-9.2
0.34662	-9.4
0.365015	-9.6
0.404656	-9.8
0.435834	-10.0
0.486132	-10.2
0.546074	-10.4
0.589262	-10.4
0.643847	-10.4
0.656279	-10.4
0.667814	-10.5
0.706518	-10.5
0.767858	-10.6
0.85212	-10.6
0.8944	-10.6
1.01398	-10.5
1.3622	-10.0
1.39506	-9.9
1.52952	-9.6
1.7012	-9.4
1.81307	-9.1
1.97009	-8.9
2.1526	-8.7

λ	dn/dT
DATA SET 16 (CONT.)	
2.32542	-8.5
2.4374	-8.5
3.3026	-8.2
3.422	-8.1
3.5070	-8.0
3.7067	-7.8
4.258	-7.5
5.01882	-7.3
5.3034	-7.2
6.0140	-7.0
6.238	-7.0
6.63306	-6.9
6.8559	-6.7
7.268	-6.5
7.4644	-6.4
8.662	-6.0
9.724	-5.6
DATA SET 17	
T = 310.0	
0.6328	-11.8
1.15	-12.0
3.39	-11.5
DATA SET 18	
T = 330.0	
0.6328	-12.4
1.15	-12.6
3.39	-12.0
DATA SET 19	
T = 350.0	
0.6328	-12.7
1.15	-13.1
3.39	-12.4

TABLE 14. EXPERIMENTAL TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF CALCIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX , dn/dT, 10^{-6} K^{-1})

λ	dn/dT
DATA SET 20	
T = 318.0	
0.6328	-13.1
1.15	-13.4
3.39	-12.8
DATA SET 21	
T = 318.0	
0.325	-10.5
0.4416	-11.4
0.6328	-11.9
1.15	-12.8
3.39	-11.5

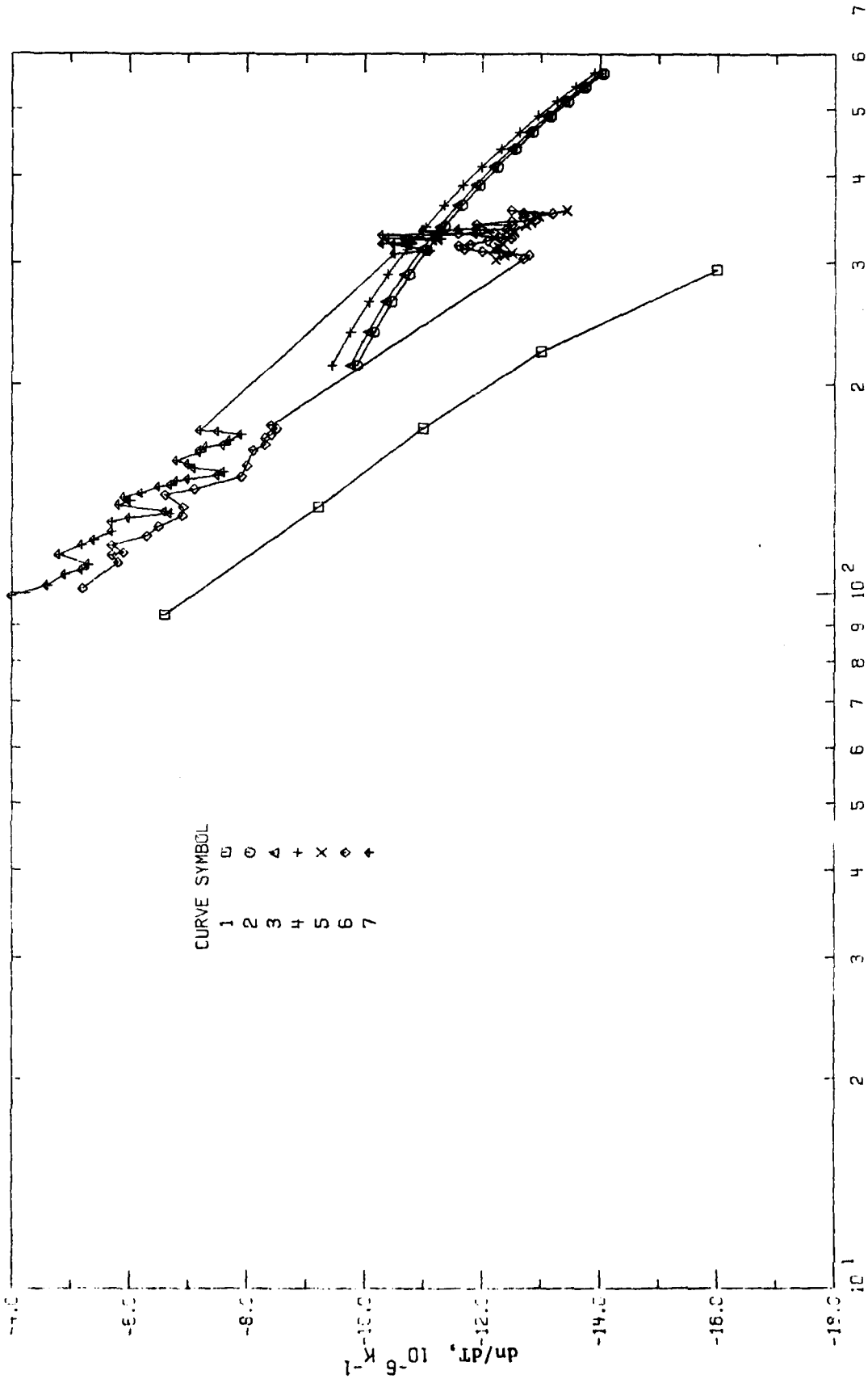


FIGURE 11. TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF CALCIUM FLUORIDE (TEMPERATURE DEPENDENCE).

TABLE 15. MEASUREMENT INFORMATION ON THE TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF CALCIUM FLUORIDE (TEMPERATURE DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	47	HOUSTON,T.W. JOHNSON,L.F. KISLIUK,P. WALSH,D.J.	1963	D	0.5461	93-293	SINGLE CRYSTAL; HIGH PURITY; PRISMATIC SPECIMEN; POLISHED SURFACES FLAT TO 1/2 WAVELENGTH OF 0.535 MICROMETER LINE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD; DN/DT DETERMINED USING INDICES MEASURED AT 93 TO 293K, FOR 0.5461 MICROMETER; DATA EXTRACTED FROM A TABLE.
2	68	SELEZNEVA,A.M.	1969	I	0.656	213-573	SYNTHETIC CRYSTAL; PRODUCED IN THE SOVIET UNION; WELL ANNEALED; DN/DT DETERMINED BY INTERFERENCE METHOD; EMPIRICAL FORMULA PROPOSED FOR CALCULATION OF DN/DT; DATA EXTRACTED BY EVALUATING A GIVEN EQUATION.
3	68	SELEZNEVA,A.M.	1969	I	0.589	213-573	SIMILAR TO ABOVE BUT FOR WAVELENGTH 0.589 MICROMETERS.
4	68	SELEZNEVA,A.M.	1969	I	0.486	213-573	SIMILAR TO ABOVE BUT FOR WAVELENGTH 0.486 MICROMETERS.
5	59	LIPSON,H.G. TSAY,Y.F. BENDOW,B LIGOR,P.A.	1976	I	1.15	300-360	SINGLE CRYSTAL; DISC SPECIMEN; 1.90CM DIAMETER, 1CM TO 2.5CM THICK; DN/DT DETERMINED BY OBSERVING THE INTERFERENCE FRINGE CHANGES AND THE CORRESPONDING TEMPERATURE CHANGES; DATA EXTRACTED FROM A FIGURE; UNCERTAINTY OF DN/DT ABOUT $0.5 \times 10^{-6} K^{-1}$.
6	92	TSAY,Y.F. LIPSON,H.G. LIGOR,P.A.	1977	I	0.6328	100-360	SINGLE CRYSTAL; DISC SPECIMEN; 1.90CM DIAMETER, 1.27CM THICK; DN/DT DETERMINED BY OBSERVING THE INTERFERENCE FRINGE CHANGES AND THE CORRESPONDING TEMPERATURE CHANGES DATA EXTRACTED FROM A FIGURE; UNCERTAINTY OF DN/DT ABOUT $1.0 \times 10^{-6} K^{-1}$.
7	92	TSAY,Y.F. ET AL.	1977	I	0.325	100-340	SIMILAR TO ABOVE BUT FOR WAVELENGTH 0.325 MICROMETERS; UNCERTAINTY OF DN/DT $1.0 \times 10^{-6} K^{-1}$.

TABLE 16. EXPERIMENTAL TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF CALCIUM FLUORIDE (TEMPERATURE DEPENDENCE)

(WAVELENGTH, λ, μm: TEMPERATURE, T, K: TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX , dn/dT, 10^{-6} K^{-1})

T	dn/dT	T	dn/dT	T	dn/dT	T	dn/dT	T	dn/dT
DATA SET 1		DATA SET 3(CONT.)		DATA SET 5(CONT.)		DATA SET 6(CONT.)		DATA SET 7(CONT.)	
λ = 0.546									
		488.0	-13.10	357.009	-13.445	345.1	-12.9	166.0	-7.7
93.0	-6.6	513.0	-13.40			347.9	-12.7	168.8	-7.9
133.0	-9.2	538.0	-13.71	DATA SET 6		349.7	-12.8	170.7	-7.5
173.0	-11.0	563.0	-14.01	λ = 0.632		353.4	-12.7	171.6	-7.2
223.0	-13.0					353.7	-13.2	309.0	-10.5
293.0	-16.0	DATA SET 4		101.5	-5.2	357.1	-12.5	312.6	-11.1
		λ = 0.486		110.7	-5.8			313.6	10.9
DATA SET 2				113.5	-5.7	DATA SET 7		318.2	-10.5
λ = 0.656		213.0	-9.43	114.4	-5.9	λ = 0.325		319.1	-10.8
		238.0	-9.75	117.2	-5.7			319.2	-10.3
213.0	-9.86	263.0	-10.07	120.9	-6.3	99.0	-4.0	321.0	-10.8
238.0	-10.16	288.0	-10.39	124.6	-6.5	102.6	-4.6	322.8	-10.7
263.0	-10.46	313.0	-10.71	129.2	-6.9	106.3	-4.9	324.6	-11.2
288.0	-10.76	339.0	-11.03	132.9	-6.9	108.1	-5.2	324.7	-10.4
313.0	-11.06	363.0	-11.35	138.4	-6.6	109.9	-5.3	324.6	-11.3
338.0	-11.36	388.0	-11.67	141.2	-7.1	113.7	-4.8	328.4	-10.3
363.0	-11.66	413.0	-11.99	146.8	-7.9	117.3	-5.2	330.1	-11.9
388.0	-11.96	438.0	-12.31	152.3	-8.0	119.1	-5.4	330.2	-11.3
413.0	-12.26	463.0	-12.63	160.6	-8.1	122.8	-5.7	333.0	-11.8
438.0	-12.56	488.0	-12.95	163.4	-8.3	126.5	-5.7	334.7	-11.9
463.0	-12.86	513.0	-13.27	167.1	-8.3	128.3	-6.0	335.7	-11.6
488.0	-13.16	538.0	-13.59	168.9	-8.4	130.1	-6.7		
513.0	-13.46	563.0	-13.91	172.6	-8.5	131.0	-6.6		
538.0	-13.76			174.4	-8.4	133.9	-5.8		
563.0	-14.06	DATA SET 5		303.7	-12.7	135.7	-6.0		
		λ = 1.15		307.4	-12.8	137.6	-5.9		
DATA SET 3				311.9	-12.0	139.4	-6.2		
λ = 0.589		303.174	-12.238	313.7	-11.7	142.1	-6.5		
		307.054	-12.378	317.4	-11.8	143.0	-6.7		
213.0	-9.74	309.508	-12.508	318.4	-11.8	144.9	-6.8		
238.0	-10.05	313.753	-12.195	323.0	-12.1	145.8	-7.0		
263.0	-10.35	315.736	-12.243	325.7	-12.3	147.6	-7.5		
288.0	-10.66	319.955	-12.355	325.8	-12.5	149.4	-7.6		
313.0	-10.96	324.966	-12.426	330.3	-11.8	151.3	-7.1		
338.0	-11.27	327.920	-12.496	331.3	-12.2	153.2	-7.0		
363.0	-11.57	331.692	-12.541	334.9	-12.0	155.0	-6.8		
388.0	-11.88	333.523	-12.540	335.0	-12.4	159.6	-7.2		
413.0	-12.18	339.647	-12.744	339.6	-12.5	160.6	-7.2		
438.0	-12.49	342.706	-12.817	340.5	-11.9	162.4	-7.3		
463.0	-12.79	350.656	-12.960	344.2	-12.5	163.3	-7.6		

TABLE 17. COMPARISON OF DISPERSION EQUATIONS PROPOSED FOR CaF_2

Source	Wavelength and Temperature Ranges	Dispersion Equation λ in μm; ν in cm^{-1}
Carvallo, M.E. 1893	0.63-1.85 μm 293 K	$\frac{1}{n^2} = 0.490335 - 0.000713835\,\ell^{-2} + 0.001584\,\ell^{2} - 0.000001042\,\ell^{-4}$ where $\ell = \frac{\lambda}{n}$
Paschen, F. 1894	0.88-9.43 μm 291.0 K	$\frac{1}{n^2} = 0.490133 - 0.00067877\,\ell^{-2} + 0.0016894\,\ell^{2} - 0.000001578\,\ell^{-4}$ where $\ell = \frac{\lambda}{n}$
Paschen, F. 1895	0.88-7.66 μm 290 K	$n^2 = 2.03882 + \frac{0.00621828}{\lambda^2 - 0.007706} - 0.00319987\,\lambda^2 - 0.0000029160\,\lambda^4$
Paschen, F. 1901	0.88-7.07 μm 284 K	$n^2 = 2.03913 - \frac{0.006125}{\lambda^2 - 0.008884} - 0.0032055\,\lambda^2 - 0.000002894\,\lambda^4$
Martens, F.F. 1901	0.18-0.77 μm 291 K	$n^2 = 1.361140 + \frac{0.677860\,\lambda^2}{\lambda^2 - (0.0950790)^2} + \frac{0.160020\,\lambda^2}{\lambda^2 - (24.0)^2} + \frac{0.193620\,\lambda^2}{\lambda^2 - (31.6)^2} + \frac{4.527470\,\lambda^2}{\lambda^2 - (40.52605)^2}$

TABLE 17. COMPARISON OF DISPERSION EQUATIONS PROPOSED FOR CaF_2 (continued)

Source	Wavelength and Temperature Ranges	Dispersion Equation λ in μm; ν in cm^{-1}
Kaiser, W., Spitzer, W.G., Kaiser, R.H., and Howarth, L.E. 1962	10-80 μm	$n^2 - k^2 = \epsilon_\infty + \sum_i 4\pi\rho_i \nu_i^2 \frac{\nu_i^2 - \nu^2}{(\nu_i^2 - \nu^2)^2 + \gamma_i \nu^2 \nu_i^2}$ $2nk = \sum_i 4\pi\rho_i \nu_i^2 \frac{\gamma_i \nu \nu_i}{(\nu_i^2 - \nu^2)^2 + \gamma_i \nu^2 \nu_i^2}$ *
Malitson, I.H. 1963	0.23-9.7 μm 297 K	$n^2 = 1 + \frac{0.5675888\,\lambda^2}{\lambda^2 - (0.050263605)^2} + \frac{0.4710914\,\lambda^2}{\lambda^2 - (0.1003909)^2} + \frac{3.8484723\,\lambda^2}{\lambda^2 - (34.649040)^2}$
Eastman Kodak Co. 1971	1.0-11.0 μm 293 K	$n = 1.4278071 + \frac{2.2806966 \times 10^{-3}}{\lambda^2 - 0.028} - \frac{9.1939015 \times 10^{-5}}{(\lambda^2 - 0.028)^2} - 1.1165792 \times 10^{-3}\,\lambda^2 - 1.5949659 \times 10^{-6}\,\lambda^4$

* $i = 1, 2$; $4\pi\rho_1 = 4.20$, $4\pi\rho_2 = 0.40$; $\nu_1 = 257\ cm^{-1}$, $\nu_2 = 328\ cm^{-1}$; $\gamma_1 = 0.018$, $\gamma_2 = 0.35$; $\epsilon_\infty = 2.045$.

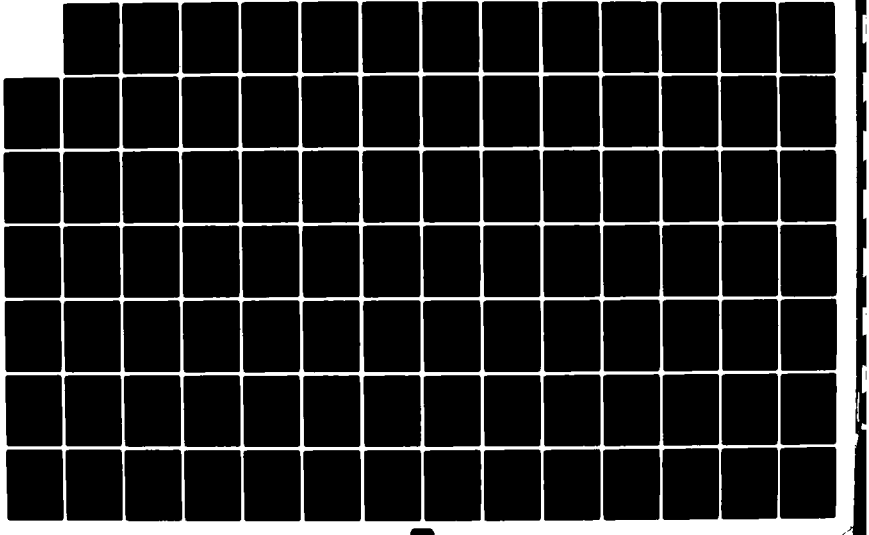
TABLE 17. COMPARISON OF DISPERSION EQUATIONS PROPOSED FOR CaF_2 (continued)

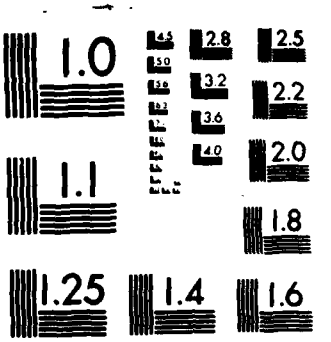
Source	Wavelength and Temperature Ranges	Dispersion Equation λ in μm; ν in cm^{-1}
Field, G.R. and Wilkinson, G.R. 1973	0.2138-5.187 μm 293 K	$n^2 - k^2 = \epsilon_\infty + \sum_i \frac{4\pi\rho_i (\nu_i^2 - \nu^2)\,\nu_i^2}{(\nu_i^2 - \nu^2)^2 + \gamma^2 \nu_i^2 \nu^2}$ $2nk = \sum_i \frac{4\pi\rho_i (\gamma_i \nu_i^3 \nu)}{(\nu_i^2 - \nu^2)^2 + \gamma^2 \nu_i^2 \nu^2}$ *
Present work 1977	0.15-12.0 μm 293 K	$n^2 = 1.33973 + \frac{0.69913\,\lambda^2}{\lambda^2 - (0.09374)^2} + \frac{0.11994\,\lambda^2}{\lambda^2 - (21.18)^2} + \frac{4.35181\,\lambda^2}{\lambda^2 - (38.46)^2}$

* $i = 1, 2, 3$; $4\pi\rho_1 = 0.370$, $4\pi\rho_2 = 0.032$, $4\pi\rho_3 = 0.036$; $\nu_1 = 266.0$, $\nu_2 = 328.0$, $\nu_3 = 83500.0$; $\gamma_1 = 0.052$, $\gamma_2 = 0.350$, $\gamma_3 = 0.130$; $\epsilon_\infty = 2.518$.

AD-A129 101 REFRACTIVE INDEX OF ALKALINE EARTH HALIDES AND ITS WAVELENGTH AND TEMPERATURE DERIVATIVES(U) THERMOPHYSICAL AND ELECTRONIC PROPERTIES INFORMATION 2/3

UNCLASSIFIED ANALYSIS .. H H LI SEP 77 CINDAS-44 F/G 7/2 NL





3.2 Strontium Fluoride, SrF_2

Strontium fluoride, one of the fluorite-type crystals, is of considerable interest from the experimental and theoretical point of view. The compound is ionic but, in contrast to NaCl-type crystals, it has a number of structural features associated primarily with the presence of two equivalent F^- ions in a unit cell.

Strontium fluoride crystal has a large electronic forbidden gap and therefore the fundamental absorption is found to be in the vacuum ultraviolet beyond 10 eV. As a consequence, transparency of the crystal extends into ultraviolet region to as low as 0.12 micrometer. This makes strontium fluoride a material useful in fabrication of optical components for vacuum ultraviolet investigations.

The strontium fluoride crystal belongs to the space group O_h^5 and is expected to have one infrared active transverse optical mode (TO) of vibration. The corresponding strong resonant absorption occurs at about 46 micrometers. However, the long wavelength limit of transparency for optical usages is about 20 micrometers.

Although the crystal is transparent from 0.12 up to 20 micrometers, only in the region 0.3-7 micrometers is the dispersion low and the transmission high. Less transmission and higher dispersion are found near the low and high limits. From

the point of view of optical applications, the crystal is a good window material for wavelengths from 0.3 to 7.0 micrometers, and is a preferred material of dispersion devices, such as prisms, for regions near the ultraviolet and infrared limits of the crystal.

Having low dispersion and high transmission in the spectral region of 2-6 micrometers, being not hygroscopic, having a high optical figure of merit and having better mechanical properties than the alkali halides, the strontium fluoride crystal is among the serious candidates for laser window materials. The widespread use of SrF_2 as a host crystal in laser applications encouraged attempts to grow single crystals with low impurity content. However, difficulties were experienced in the growth of pure crystals because of the low electronic mobility of conduction electrons in the crystal. Synthetic material of high purity is now commercially available or may be made by reacting the purified oxide or chloride with gaseous HF. Single crystals of SrF_2 can be grown by using the Stockbarger-Bridgman technique if adequate precautions are taken to eliminate oxygen and water from the atmosphere of the growing process. The crystal cleaves readily along {1,1,1} planes which meet to form <1,1,0> cleavage edges. The cleavage is of value in the alignment of specimens.

It would be misleading to think that the optical properties of SrF have been extensively studied and that experimental data are readily at our disposal. A quick scan of the data will show

that there are wide gaps and large discrepancies! see figure 12 and tables 19 and 20.

Strontium fluoride is receiving considerable attention since it has a nearly ideal host lattice for paramagnetic ions. The ionic radius of Sr^{++}(1.10A) is close to those of the ions of the rare-earth group and certain elements of the actinide group. Strontium fluoride doped with up to one percent of some foreign ions demonstrates observable fluorescence. Because of this, some investigations have been directed toward finding evidence of interactions between electronic transitions and lattice vibrations of this host crystal. Data from this work is concentrated near the restrahlen region. Only one set of data is available for the refractive index in the infrared region from 15 to 80 micrometers: Kaiser et al. [17]. The accuracy of this set of data is open to question because it was deduced from the reflection spectrum by classic dispersion theory. However, the spectral positions obtained for the fundamental absorption peaks were in agreement with those obtained from other sources. In addition, the static dielectric constant derived from the dispersion equation agrees with their own experimental values, which in turn agree with measurements of Andeen et al. [19] and of Lowndes [15]. This additional evidence positively support the correctness of their positions for the infrared absorption peaks.

At the other extreme, research activities were directed toward finding the electronic structure of the crystal. Since

strontium fluoride has a large forbidden gap, much of the work was carried out in the vacuum ultraviolet. Lukirskii et al.[63] measured the refractive index for the wavelength region from 0.002 to 0.112 micrometer, Niser et al.[25] for 0.03 to 0.1234 micrometer and Ganin et al.[53] for 0.06 to 0.25 micrometer. Since all of them obtained their results by reducing the observed reflection spectra, discrepancies among their results are to be expected. However, all these studies yield similar structures for the spectrum of the refractive index in the vacuum ultraviolet, as shown in figure 12.

With regard to the refractive index in the transparent region, 0.3 to 7.0 micrometers, it is unfortunate that data are available only through three experimental investigations. Refractive indices for the mean of the sodium D lines and for 4.5 micrometers were reported by Wulff et al. [62] and by Gisin [64], respectively. Gisin's values, which were obtained for thin films of various thickness, are expected to be lower than that of the bulk crystal. The only data set which covers a wide transparent region from 0.37 to 10 micrometer is a set of preliminary data by the OPTOVAC company, compiled by Dickison [65]. As the data set was presented in a coarse diagram, values read from this diagram carry large uncertainty, particularly in the near ultraviolet region where the plotted diagram curves most. As a result, the values read from the diagram are not adequate for data analysis. In addition, Dickison quoted two values for refractive indices at wavelengths 4.0 and 10.0 micrometers. The value at 4.0

micrometer is 1.44 (for a Harshaw grown crystal) which differs considerably from that read from the OPTOVAC diagram, about 1.41. The value at 10.0 micrometers is 1.36, which is consistent with the value from the diagram. Therefore, we are left only one single reliable refractive index value, that for the mean of the sodium D lines by Wulff. The value 1.36 at 10.0 micrometers, though not accurate, will be used to evaluate the coefficients for infrared terms.

From this brief review of available data, it may appear that we lack data to make recommendations. However, we are not prevented from making resonable predictions because we do have information on infrared absorption peaks, the static dielectric constant, the optical dielectric constant and the available refractive indices at 0.589 micrometer by Wulff [62] and at 10 micrometer from OPTOVAC diagram. A correlation of these quantities through the dispersion equation is possible. Since reliability of the predicted value depends largely on the reliability of these parameters, a careful selection of the available data for these parameters plays a decisive role in making recommendations.

The available data on the optical and static dielectric constants and the wavelength of the fundamental optical phonon for SrF_2 are given in tables 4, 5, and 6, where values reported by different authors were grouped to facilitate an easy comparison. From these tables, the parameters at room

temperature are chosen:

ε_0 =6.4679±0.0006 (Andeen et al.),

λ_{LO} =26.03 μm, average of two entries in table 6,

λ_{TO} =45.6±0.6 μm, average of three entries in table 6.

Furthermore, two facts were observed in the study of CaF_2 and BaF_2: the value of the constant term in each of the dispersion equations is the same, 1.33973, and the effective wavelength of the ultraviolet absorption band in each case agrees closely with that estimated from Rubloff's work. Assuming that this is also the case for SrF_2, the coefficient of the ultraviolet term can easily be determined. As the contributions of the infrared terms to the refractive index at 0.589 micrometer are negligibly small, the uv coefficient can be obtained by including the first two terms in the dispersion equation. Using Wulff's value, n=1.442, a simple calculation yields a value 0.720 for the coefficient, which agrees well with the value, 0.73, based on the difference of the optical dielectric constant and the constant in the dispersion equation.

In the determination of the coefficients of infrared terms, two observations are taken as guides. In the first place, the sum of the coefficients in the dispersion equation should agree with the static dielectric constant. However, in the cases of CaF_2 and BaF_2 this sum is less than the corresponding static dielectric constants, about 0.3 less for CaF_2 and 0.5 less for BaF_2, because of the approximation of neglecting the effects of damping factors and absorption bands other than the predominant

ones. A similar difference is likely to hold for SrF_2, and a value of 0.4 is assigned to the discrepancy, corresponding to the average of those for CaF_2 and BaF_2. The second fact is that the contribution to the refractive index from the TO phonon predominates over that of the LO phonon. With these considerations, and by using the value 1.36 for the refractive index at 10 micrometers, the coefficients of the infrared terms can be calculated. The results are 3.940 for the TO term and 0.066 for the LO term.

The dispersion equation thus obtained is

$$n^2 = 1.33973 + \frac{0.720\,\lambda^2}{\lambda^2 - 0.09566^2} + \frac{0.066\,\lambda^2}{\lambda^2 - 26.03^2} + \frac{3.94\,\lambda^2}{\lambda^2 - 45.60^2}, \qquad (18)$$

Where λ is in unit of micrometer. When this equation is used to evaluate the refractive index at 4.0 micrometers, the result is 1.424, about 0.014 higher than that obtained from the OPTOVAC diagram and about 0.016 lower than that of the Harshaw crystal. The following consideration would lend support to our prediction. On close examination of the OPTOVAC diagram, one will find that a wide section of the curve between 1.0 to 10 micrometers is actually a straight line, probably constructed by connecting the data points at visible wavelengths and at 10 micrometers. This is in contradiction to the general behavior of the refractive index as a function of wavelength. As a rule of thumb, the refractive index varies slowly in the wide middle section of transparent region, but large variations occur near the ends.

According to this rule, the refractive index at 4.0 micrometer should be higher than the diagram indicates. The quoted refractive index value for the Harshaw crystal is apparently too high for pure strontium fluoride. A simple calculation shows that this value is the square root of the optical dielectric constant. The contribution to the refractive index in the transparent region from the infrared terms is always negative. At 4.0 micrometer, the refractive index must be lower than the square root of optical dielectric constant. The high refractive index for the Harshaw crystal is probably due to impurities.

Equation (18) is used to represent the refractive index of SrF_2 at 293K from 0.15 to 14.0 micrometers. As this equation is obtained mainly by correlation of physical parameters which are either available through literature or estimated empirically, large uncertainties are expected, especially near the limits the of transparent region. The estimated uncertainties in the refractive index for the wide middle section, where the dispersion is low, is about 0.005. In the ultraviolet region from 0.15 to 0.3 micrometer, additional uncertainty is estimated using the formula:

$$\Delta n = \frac{0.720\,\lambda^2}{(\lambda^2 - \lambda_u^2)^2}\left(\frac{\lambda_u\,\Delta\lambda_u}{n}\right), \qquad (19)$$

where $\Delta\lambda_u = 0.119 - \lambda_u$. In the infrared region from 7.0 to 14.0 micrometers the additional uncertainty mainly comes from the uncertainty (estimated at 0.4) in the static dielectric constant.

The predominant contribution to the uncertainty is $\Delta n = \left(\frac{1}{2n}\right)\left(\frac{0.4}{\lambda^2 - 45.6^2}\right)$.

Although SrF_2 has been recognized as a good optical material, especially for laser applications where the temperature derivative of the refractive index is a parameter of prime importance, the experimental data on the refractive index is scarce. With regard to dn/dT data nothing was available until, recently, Lipson et al. [59] reported dn/dT measurement for three spectral lines, 0.6328, 1.15 and 3.39 micrometers, and Tsay et al. [92] reported measurements for five lines, 0.325, 0.4416, 0.6328, 1.15 and 3.39 micrometers. The available dn/dT data is found to fit the equation

$$2n\frac{dn}{dT} = -28.0 - 55.2(n^2 - 1) + \frac{50.0\,\lambda^4}{(\lambda^2 - 0.09566^2)^2} + \frac{198.1\,\lambda^2}{\lambda^2 - 45.6^2} + \frac{1980.8\,\lambda^4}{(\lambda^2 - 45.6^2)^2} \quad (20)$$

Equations (18) and (20) were used to generate the reference data given in the table of recommended values. Values of $dn/d\lambda$ were simply evaluated by the first derivative of eq (18). Although values of n are given to the fifth decimal place and dn/dT to the first, this does not reflect the reliability of the numbers; they are so given simply for smoothness of tabulation. For the proper use of the tabulated values the reader should follow the criteria given below.

For refractive index:

Wavelength range micrometer	Estimated uncertainty, ±
0.15-0.20	0.05
0.20-0.30	0.02
0.30-0.40	0.01
0.40-7.0	0.005
7.0-10.0	0.01
10.0-14.0	0.02

For dn/dT:

0.15-0.20	>3.0
0.20-0.30	3.0
0.30-1.0	1.5
1.0-6.0	1.0
6.0-9.0	1.5
9.0-10.0	2.0
10.0-14.0	3.0

TABLE 18. RECOMMENDED VALUES ON THE REFRACTIVE INDEX AND ITS WAVELENGTH AND TEMPERATURE DERIVATIVES FOR STRONTIUM FLUORIDE AT 293K*

λ μm	n	-dn/dλ μm^{-1}	dn/dT 10^{-6} K^{-1}	λ μm	n	-dn/dλ μm^{-1}	dn/dT 10^{-6} K^{-1}	λ μm	n	-dn/dλ μm^{-1}	dn/dT 10^{-6} K^{-1}
0.150	1.59799	3.47099	8.9	0.270	1.47069	0.29808	-9.1	0.700	1.43960	0.01482	-12.3
0.152	1.59119	3.23292	7.7	0.272	1.47010	0.29034	-9.2	0.720	1.43932	0.01371	-12.3
0.154	1.58494	3.01785	6.7	0.274	1.46953	0.28303	-9.2	0.740	1.43905	0.01271	-12.3
0.156	1.57910	2.82292	5.7	0.276	1.46897	0.27593	-9.3	0.760	1.43881	0.01182	-12.3
0.158	1.57364	2.64570	4.8	0.278	1.46843	0.26904	-9.4	0.780	1.43858	0.01103	-12.4
0.160	1.56851	2.48413	4.0	0.280	1.46790	0.26246	-9.4	0.800	1.43837	0.01032	-12.4
0.162	1.56369	2.33642	3.2	0.282	1.46738	0.25606	-9.5	0.820	1.43817	0.00968	-12.4
0.164	1.55916	2.20104	2.5	0.284	1.46687	0.24987	-9.5	0.840	1.43798	0.00910	-12.4
0.166	1.55488	2.07669	1.9	0.286	1.46638	0.24389	-9.6	0.860	1.43780	0.00858	-12.4
0.168	1.55084	1.96217	1.3	0.288	1.46590	0.23810	-9.6	0.880	1.43764	0.00811	-12.4
0.170	1.54703	1.85652	0.7	0.290	1.46542	0.23250	-9.7	0.900	1.43748	0.00768	-12.4
0.172	1.54341	1.75883	0.2	0.292	1.46497	0.22709	-9.7	0.920	1.43733	0.00729	-12.5
0.174	1.53998	1.66834	-0.3	0.294	1.46452	0.22184	-9.8	0.940	1.43719	0.00694	-12.5
0.176	1.53673	1.58436	-0.8	0.296	1.46408	0.21676	-9.8	0.960	1.43705	0.00662	-12.5
0.178	1.53364	1.50630	-1.2	0.298	1.46365	0.21184	-9.9	0.980	1.43692	0.00633	-12.5
0.180	1.53070	1.43361	-1.6	0.300	1.46323	0.20707	-9.9	1.000	1.43680	0.00606	-12.5
0.182	1.52791	1.36582	-2.0	0.305	1.46222	0.19577	-10.0	1.050	1.43651	0.00549	-12.5
0.184	1.52524	1.30250	-2.4	0.310	1.46127	0.18530	-10.1	1.100	1.43625	0.00503	-12.5
0.186	1.52269	1.24328	-2.7	0.315	1.46037	0.17559	-10.2	1.150	1.43600	0.00466	-12.6
0.188	1.52026	1.18781	-3.1	0.320	1.45951	0.16657	-10.3	1.200	1.43578	0.00436	-12.6
0.190	1.51794	1.13579	-3.4	0.325	1.45870	0.15816	-10.4	1.250	1.43557	0.00412	-12.6
0.192	1.51572	1.08694	-3.7	0.330	1.45793	0.15033	-10.5	1.300	1.43537	0.00392	-12.6
0.194	1.51359	1.04101	-4.0	0.335	1.45720	0.14303	-10.6	1.350	1.43518	0.00376	-12.6
0.196	1.51155	0.99778	-4.2	0.340	1.45650	0.13620	-10.6	1.400	1.43499	0.00364	-12.6
0.198	1.50960	0.95705	-4.5	0.345	1.45584	0.12981	-10.7	1.450	1.43481	0.00354	-12.6
0.200	1.50772	0.91863	-4.7	0.350	1.45520	0.12382	-10.8	1.500	1.43464	0.00346	-12.6
0.202	1.50592	0.88235	-4.9	0.355	1.45460	0.11820	-10.8	1.550	1.43447	0.00340	-12.6
0.204	1.50419	0.84805	-5.2	0.360	1.45402	0.11293	-10.9	1.600	1.43430	0.00336	-12.6
0.206	1.50253	0.81561	-5.4	0.365	1.45347	0.10798	-10.9	1.650	1.43413	0.00333	-12.6
0.208	1.50093	0.78488	-5.6	0.370	1.45294	0.10332	-11.0	1.700	1.43396	0.00331	-12.6
0.210	1.49939	0.75576	-5.8	0.375	1.45243	0.09893	-11.0	1.750	1.43380	0.00330	-12.6
0.212	1.49790	0.72814	-5.9	0.380	1.45195	0.09479	-11.1	1.800	1.43363	0.00330	-12.7
0.214	1.49647	0.70191	-6.1	0.385	1.45149	0.09088	-11.1	1.850	1.43347	0.00331	-12.7
0.216	1.49509	0.67699	-6.3	0.390	1.45104	0.08719	-11.2	1.900	1.43330	0.00332	-12.7
0.218	1.49376	0.65329	-6.5	0.395	1.45061	0.08371	-11.2	1.950	1.43314	0.00334	-12.7
0.220	1.49248	0.63074	-6.6	0.400	1.45020	0.08041	-11.3	2.000	1.43297	0.00337	-12.7
0.222	1.49124	0.60926	-6.8	0.410	1.44943	0.07433	-11.3	2.050	1.43280	0.00340	-12.7
0.224	1.49004	0.58879	-6.9	0.420	1.44871	0.06886	-11.4	2.100	1.43263	0.00343	-12.7
0.226	1.48889	0.56927	-7.0	0.430	1.44805	0.06393	-11.5	2.150	1.43245	0.00347	-12.7
0.228	1.48777	0.55065	-7.2	0.440	1.44743	0.05948	-11.5	2.200	1.43227	0.00351	-12.7
0.230	1.48668	0.53286	-7.3	0.450	1.44686	0.05543	-11.6	2.250	1.43210	0.00355	-12.7
0.232	1.48563	0.51587	-7.4	0.460	1.44632	0.05176	-11.6	2.300	1.43192	0.00360	-12.7
0.234	1.48462	0.49962	-7.5	0.470	1.44582	0.04842	-11.7	2.350	1.43174	0.00364	-12.7
0.236	1.48363	0.48408	-7.7	0.480	1.44535	0.04536	-11.7	2.400	1.43156	0.00369	-12.7
0.238	1.48268	0.46920	-7.8	0.490	1.44492	0.04257	-11.8	2.450	1.43137	0.00375	-12.7
0.240	1.48176	0.45495	-7.9	0.500	1.44450	0.04000	-11.8	2.500	1.43119	0.00380	-12.7
0.242	1.48086	0.44130	-8.0	0.510	1.44411	0.03765	-11.9	2.550	1.43099	0.00385	-12.7
0.244	1.47999	0.42820	-8.1	0.520	1.44375	0.03549	-11.9	2.600	1.43080	0.00391	-12.7
0.246	1.47915	0.41565	-8.2	0.530	1.44340	0.03349	-11.9	2.650	1.43060	0.00397	-12.7
0.248	1.47833	0.40360	-8.3	0.540	1.44308	0.03165	-11.9	2.700	1.43040	0.00402	-12.7
0.250	1.47753	0.39203	-8.4	0.550	1.44277	0.02995	-12.0	2.750	1.43020	0.00408	-12.7
0.252	1.47676	0.38091	-8.4	0.560	1.44248	0.02837	-12.0	2.800	1.43000	0.00414	-12.7
0.254	1.47601	0.37023	-8.5	0.570	1.44220	0.02691	-12.0	2.850	1.42979	0.00421	-12.7
0.256	1.47528	0.35995	-8.6	0.580	1.44194	0.02555	-12.1	2.900	1.42958	0.00427	-12.7
0.258	1.47457	0.35007	-8.7	0.590	1.44169	0.02429	-12.1	2.950	1.42936	0.00433	-12.7
0.260	1.47388	0.34056	-8.8	0.600	1.44145	0.02311	-12.1	3.000	1.42914	0.00439	-12.7
0.262	1.47321	0.33141	-8.8	0.620	1.44101	0.02099	-12.1	3.050	1.42892	0.00446	-12.7
0.264	1.47255	0.32259	-8.9	0.640	1.44061	0.01914	-12.2	3.100	1.42870	0.00452	-12.7
0.266	1.47192	0.31409	-9.0	0.660	1.44025	0.01752	-12.2	3.150	1.42847	0.00459	-12.7
0.268	1.47130	0.30590	-9.1	0.680	1.43991	0.01609	-12.2	3.200	1.42824	0.00465	-12.7

TABLE 18. RECOMMENDED VALUES ON THE REFRACTIVE INDEX AND ITS WAVELENGTH AND TEMPERATURE DERIVATIVES FOR STRONTIUM FLUORIDE AT 293K (CONTINUED)*

λ μm	n	-dn/dλ μm^{-1}	dn/dT $10^{-6} K^{-1}$	λ μm	n	-dn/dλ μm^{-1}	dn/dT $10^{-6} K^{-1}$	λ μm	n	-dn/dλ μm^{-1}	dn/dT $10^{-6} K^{-1}$
3.250	1.42800	0.00472	-12.7	5.100	1.41684	0.00741	-12.6	8.700	1.37938	0.01366	-11.8
3.300	1.42777	0.00479	-12.7	5.200	1.41609	0.00756	-12.6	8.800	1.37800	0.01385	-11.7
3.350	1.42752	0.00485	-12.7	5.300	1.41533	0.00772	-12.6	8.900	1.37661	0.01405	-11.7
3.400	1.42728	0.00492	-12.7	5.400	1.41455	0.00788	-12.6	9.000	1.37519	0.01426	-11.6
3.450	1.42703	0.00499	-12.7	5.500	1.41375	0.00803	-12.6	9.100	1.37375	0.01446	-11.6
3.500	1.42679	0.00506	-12.7	5.600	1.41294	0.00819	-12.6	9.200	1.37230	0.01466	-11.5
3.550	1.42653	0.00513	-12.7	5.700	1.41212	0.00835	-12.6	9.300	1.37082	0.01487	-11.4
3.600	1.42627	0.00520	-12.7	5.800	1.41127	0.00851	-12.6	9.400	1.36932	0.01508	-11.4
3.650	1.42601	0.00527	-12.7	5.900	1.41041	0.00867	-12.5	9.500	1.36781	0.01529	-11.3
3.700	1.42574	0.00534	-12.7	6.000	1.40954	0.00884	-12.5	9.600	1.36627	0.01550	-11.3
3.750	1.42547	0.00541	-12.7	6.100	1.40865	0.00900	-12.5	9.700	1.36471	0.01571	-11.2
3.800	1.42520	0.00548	-12.7	6.200	1.40774	0.00916	-12.5	9.800	1.36312	0.01593	-11.1
3.850	1.42492	0.00555	-12.7	6.300	1.40681	0.00933	-12.5	9.900	1.36152	0.01615	-11.0
3.900	1.42465	0.00562	-12.7	6.400	1.40587	0.00950	-12.5	10.000	1.35989	0.01637	-11.0
3.950	1.42436	0.00569	-12.7	6.500	1.40491	0.00966	-12.5	10.200	1.35658	0.01681	-10.8
4.000	1.42409	0.00576	-12.7	6.600	1.40394	0.00983	-12.4	10.400	1.35317	0.01727	-10.6
4.050	1.42379	0.00584	-12.7	6.700	1.40295	0.01000	-12.4	10.600	1.34967	0.01773	-10.4
4.100	1.42349	0.00591	-12.7	6.800	1.40194	0.01017	-12.4	10.800	1.34607	0.01821	-10.2
4.150	1.42320	0.00598	-12.7	6.900	1.40091	0.01034	-12.4	11.000	1.34238	0.01869	-10.0
4.200	1.42289	0.00605	-12.7	7.000	1.39987	0.01052	-12.4	11.200	1.33860	0.01919	-9.8
4.250	1.42259	0.00613	-12.7	7.100	1.39881	0.01069	-12.3	11.400	1.33471	0.01969	-9.6
4.300	1.42228	0.00620	-12.7	7.200	1.39773	0.01087	-12.3	11.600	1.33072	0.02021	-9.3
4.350	1.42197	0.00628	-12.7	7.300	1.39663	0.01104	-12.3	11.800	1.32663	0.02074	-9.0
4.400	1.42165	0.00635	-12.7	7.400	1.39552	0.01122	-12.3	12.000	1.32243	0.02129	-8.7
4.450	1.42133	0.00642	-12.7	7.500	1.39439	0.01140	-12.2	12.200	1.31811	0.02183	-8.4
4.500	1.42101	0.00650	-12.7	7.600	1.39324	0.01158	-12.2	12.400	1.31369	0.02240	-8.1
4.550	1.42069	0.00657	-12.7	7.700	1.39207	0.01176	-12.2	12.600	1.30916	0.02299	-7.7
4.600	1.42035	0.00665	-12.7	7.800	1.39089	0.01195	-12.1	12.800	1.30450	0.02357	-7.4
4.650	1.42002	0.00672	-12.7	7.900	1.38969	0.01213	-12.1	13.000	1.29972	0.02419	-6.9
4.700	1.41968	0.00680	-12.6	8.000	1.38846	0.01232	-12.1	13.200	1.29483	0.02481	-6.5
4.750	1.41934	0.00687	-12.6	8.100	1.38722	0.01250	-12.0	13.400	1.28980	0.02546	-6.1
4.800	1.41900	0.00695	-12.6	8.200	1.38596	0.01269	-12.0	13.600	1.28464	0.02612	-5.6
4.850	1.41865	0.00703	-12.6	8.300	1.38468	0.01288	-11.9	13.800	1.27935	0.02680	-5.1
4.900	1.41829	0.00710	-12.6	8.400	1.38339	0.01307	-11.9	14.000	1.27392	0.02750	-4.5
4.950	1.41794	0.00718	-12.6	8.500	1.38207	0.01327	-11.9				

* IN THIS TABLE MORE DECIMAL PLACES ARE REPORTED THAN WARRANTED MERELY FOR THE PURPOSE OF TABULAR SMOOTHNESS AND INTERNAL COMPARISON. FOR UNCERTAINTIES OF TABULATED VALUES IN VARIOUS WAVELENGTH RANGES, SEE THE TEXT OF SUBSECTION 3.2.

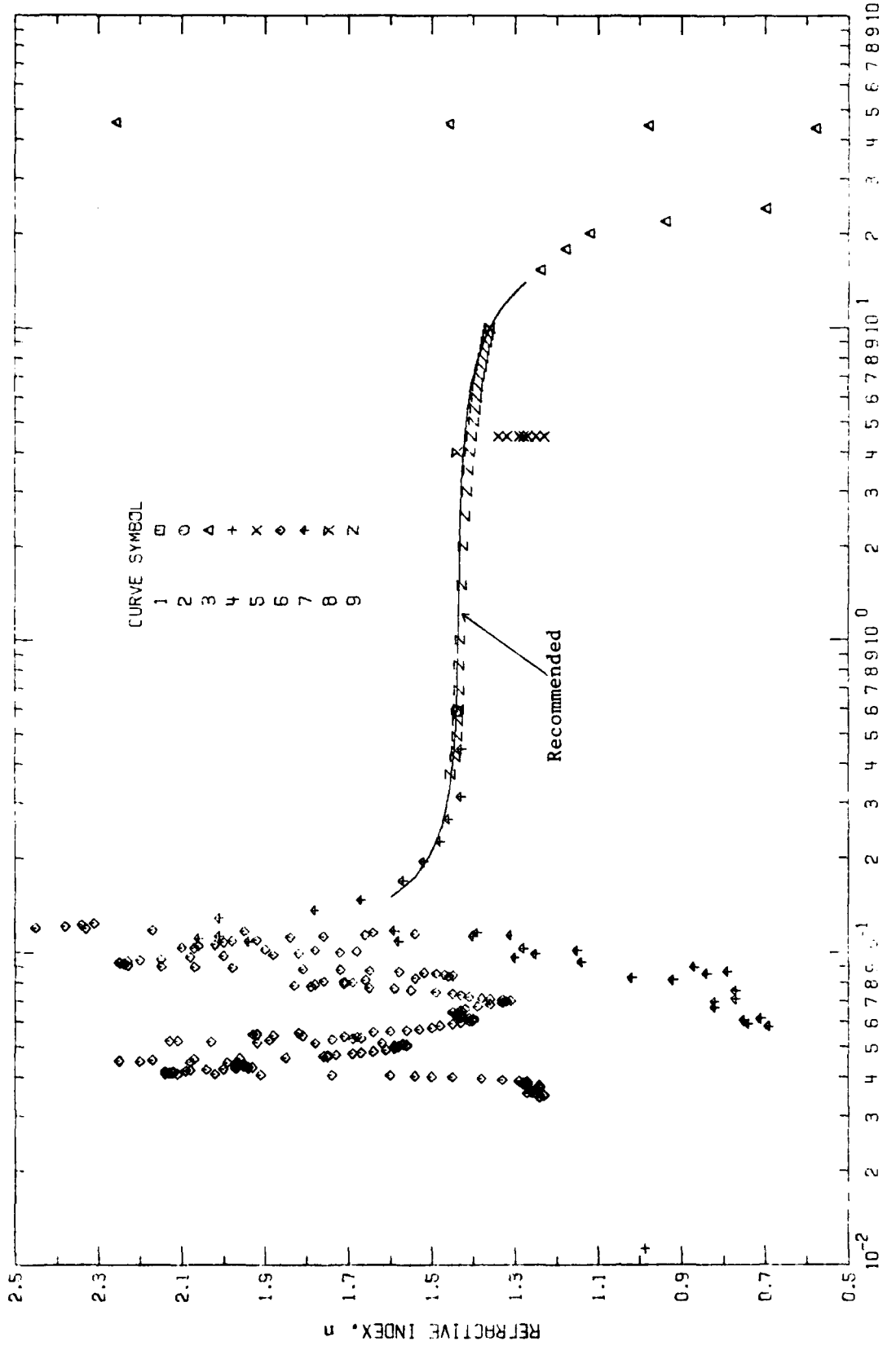


FIGURE [illegible]. REFRACTIVE INDEX OF STRONTIUM FLUORIDE (WAVELENGTH DEPENDENCE).

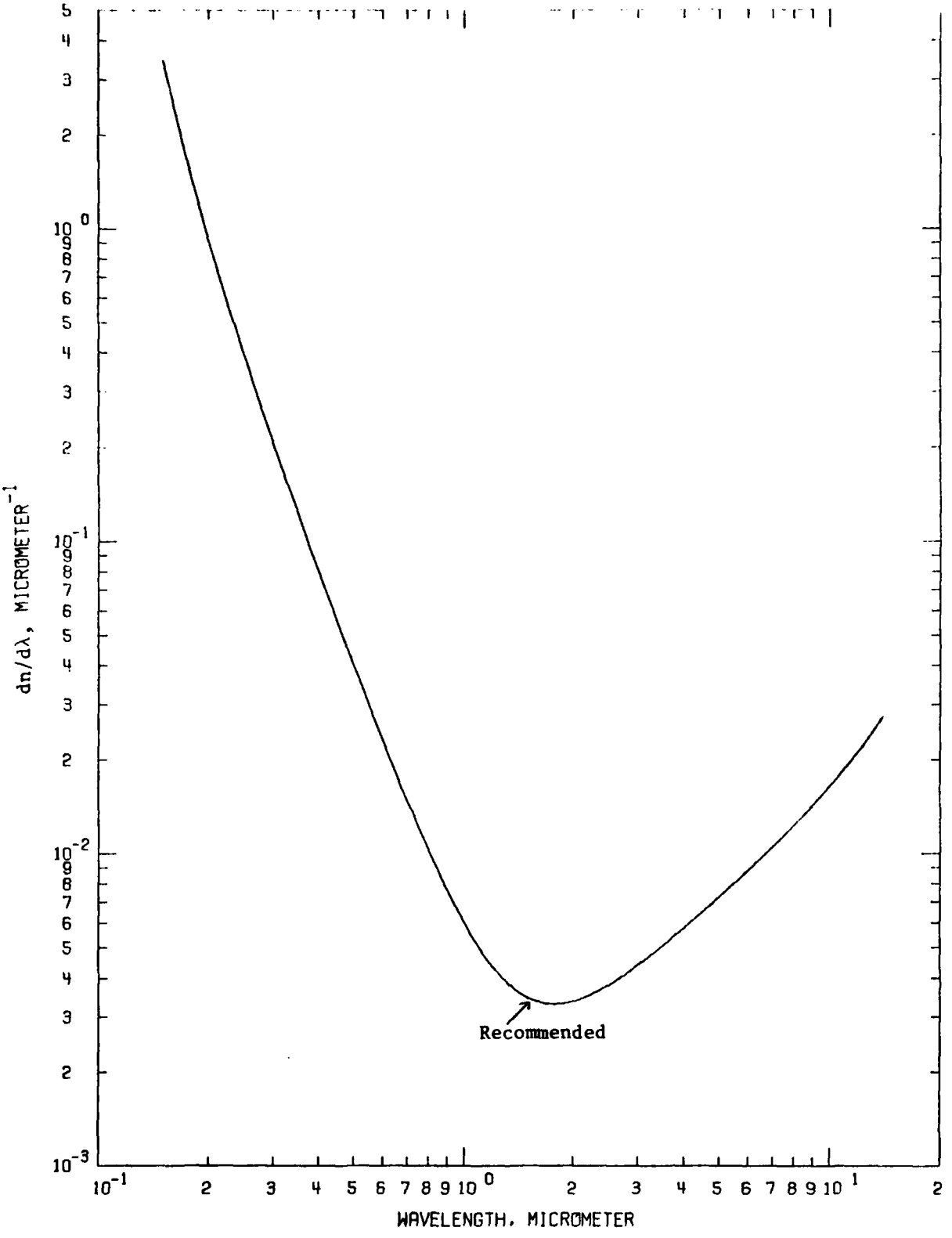


FIGURE 13. WAVELENGTH DERIVATIVE OF REFRACTIVE INDEX OF STRONTIUM FLUORIDE.

TABLE 19. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF STRONTIUM FLUORIDE (WAVELENGTH DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	61	THILO,F.	1927	M	0.589	293	SINGLE CRYSTAL; REFRACTIVE INDEX DETERMINED BY IMMERSION METHOD FOR THE MEAN OF SODIUM D LINES; DATA EXTRACTED FROM A TABLE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
2	62	WULFF,P. HEIGL,A.	1931	M	0.589	298	CRYSTAL OF UNSPECIFIED TYPE; CRYSTAL SIZE NOT LARGE ENOUGH FOR INTERFEROMETRIC MEASUREMENT; REFRACTIVE INDEX DETERMINED BY IMMERSION METHOD FOR THE MEAN OF SODIUM D LINES; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF INDEX 0.001.
3	17	KAISER,W. SPITZER,W.G. KAISER,R.H. HOWARTH,L.E.	1962	R	10.0-80.0	300	SINGLE CRYSTAL; PLATE SPECIMEN; 0.1-5.0MM THICK; HIGHLY POLISHED SURFACES; NEAR NORMAL INCIDENT REFLECTION SPECTRUM OBTAINED; REFRACTIVE INDEX DEDUCED FROM REFLECTION SPECTRUM WITH LORENTZ THEORY; DATA EXTRACTED FROM A SMOOTH CURVE; LORENTZ DAMPED-OSCILLATOR DISPERSION EQUATION ALSO GIVEN.
4	63	LUKIRSKII,A.P. SAVINOV,E.P. ERSHOV,O.A. SHEPELEV,YU.F.	1964	R	0.002-0.12	298	THIN FILM SPECIMEN OF STRONTIUM FLUORIDE ON GOLD OR ALUMINIUM SUBSTRATE; REFRACTIVE INDEX DEDUCED FROM REFLECTION SPECTRUM WITH FRESNEL FORMULAE; DATA EXTRACTED FROM A TABLE.
5	64	GISIN,M.A.	1969	I	4.5	298	THIN FILM SPECIMEN OF THICKNESS FROM 0.8 TO 7.4 MICROMETER ON SILICON OR GERMANIUM SUBSTRATE; REFRACTIVE INDEX DETERMINED BY INTERFERENCE METHOD FOR THE SPECTRAL LINE 4.5 MICROMETERS; DATA EXTRACTED FROM A TABLE.
6	25	NISAR,M. ROBIN,S.	1974	R	0.03-0.124	293	SINGLE CRYSTAL; OBTAINED FROM THE HARSHAW CHEMICAL CO.; SPECIMEN CLEAVED IN VACUUM; 20 DEGREE INCIDENT REFLECTION SPECTRUM OBTAINED; REFRACTIVE INDEX DEDUCED FROM REFLECTION SPECTRUM WITH KRAMERS-KRONIG RELATION; DATA EXTRACTED FROM A FIGURE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
7	53	GANIN,V.,SIDORIN,V. KARIN,M.,SIDORIN,K. STAROSTIN,N., STARTSEV,G.	1975	R	0.06-0.25	300	SINGLE CRYSTAL; FRESHLY CLEAVED SPECIMEN; NEAR NORMAL REFLECTION SPECTRUM OBTAINED; REFRACTIVE INDEX DEDUCED FROM REFLECTION SPECTRUM WITH KRAMERS-KRONIG RELATION; DATA EXTRACTED FROM A FIGURE.
8	65	DICKISON,S.K.	1975		4.0,10.0	293	THE DATA ARE FOR HARSHAW GROWN CRYSTAL COMPILED BY THE AUTHOR; NO DETAILS ABOUT HOW THE DATA WERE OBTAINED WAS GIVEN; TEMPERATURE NOT GIVEN, 293K ASSUMED; DATA EXTRACTED FROM A TABLE.

TABLE 19. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF STRONTIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
9	65	DICKISON, S.K.	1975		0.37-10.0	293	THIS DATA SET IS THE PRELIMINARY DATA BY OPTOVAC, INC. COMPILED BY THE AUTHOR; NO DETAILS OF THE MEASUREMENT INFORMATION WAS GIVEN; TEMPERATURE NOT GIVEN, 293K ASSUMED; DATA EXTRACTED FROM A SMOOTH CURVE.

TABLE 20. EXPERIMENTAL REFRACTIVE INDEX OF STRONTIUM FLUORIDE (WAVELENGTH DEPENDENCE)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n)

λ	n
DATA SET 1 T = 293.0	
0.589	1.438
DATA SET 2 T = 298.0	
0.589	1.442
DATA SET 3 T = 300.0	
15.3	1.24
17.9	1.18
20.1	1.12
22.8	0.94
24.1	0.70
26.1	0.37
27.6	0.16
30.0	0.16
33.8	0.16
37.6	0.16
40.8	0.21
41.8	0.33
43.6	0.58
44.6	0.98
45.0	1.46
45.3	2.26
45.4	2.99
45.4	3.70
45.6	4.48
45.6	5.20
45.8	6.01
45.8	6.67
45.9	7.57
45.9	8.51
46.0	9.30
46.0	10.07
46.0	10.85
46.2	11.59
46.5	12.30

λ	n
DATA SET 3 (CONT.)	
46.7	11.59
46.9	10.92
47.1	10.10
47.3	9.41
47.4	8.65
47.6	7.89
48.0	7.11
48.6	6.46
49.3	5.84
50.0	5.42
50.9	4.97
52.1	4.57
53.7	4.24
55.5	3.93
57.4	3.67
59.9	3.47
62.9	3.31
66.3	3.15
70.0	3.05
73.8	2.95
76.7	2.89
80.0	2.86
DATA SET 4 T = 298.0	
0.00236	0.9991
0.00314	0.9989
0.0044	0.9987
0.0067	0.99666
0.0113	0.9869
DATA SET 5 T = 298.0	
4.5	1.34
4.5	1.32
4.5	1.29
4.5	1.28
4.5	1.27

λ	n
DATA SET 5 (CONT.)	
4.5	1.25
4.5	1.23
DATA SET 6 T = 293.0	
0.0345	1.24
0.0349	1.23
0.0351	1.23
0.0354	1.25
0.0356	1.27
0.0358	1.26
0.0361	1.26
0.0364	1.25
0.0369	1.24
0.0372	1.24
0.0374	1.24
0.0376	1.24
0.0379	1.27
0.0381	1.28
0.0383	1.28
0.0385	1.27
0.0386	1.27
0.0388	1.29
0.0392	1.33
0.0396	1.38
0.0400	1.45
0.0401	1.50
0.0403	1.54
0.0405	1.60
0.0406	1.74
0.0407	1.91
0.0409	2.02
0.0410	2.11
0.0411	2.14
0.0413	2.13
0.0414	2.12
0.0416	2.12
0.0417	2.14
0.0418	2.14

λ	n
DATA SET 6 (CONT.)	
0.0420	2.09
0.0421	2.08
0.0423	2.04
0.0424	2.00
0.0426	1.97
0.0429	1.94
0.0430	1.93
0.0432	1.94
0.0433	1.95
0.0435	1.97
0.0436	1.97
0.0438	1.96
0.0439	1.95
0.0442	1.97
0.0444	1.99
0.0446	2.08
0.0449	2.20
0.0450	2.25
0.0452	2.25
0.0454	2.17
0.0457	2.07
0.0459	1.96
0.0462	1.85
0.0464	1.75
0.0466	1.75
0.0467	1.76
0.0469	1.75
0.0471	1.73
0.0475	1.69
0.0478	1.67
0.0482	1.64
0.0488	1.61
0.0494	1.59
0.0496	1.59
0.0497	1.59
0.0500	1.59
0.0502	1.58
0.0504	1.56
0.0506	1.56
0.0508	1.57

λ	n
DATA SET 6 (CONT.)	
0.0510	1.57
0.0512	1.62
0.0514	1.78
0.0516	1.92
0.0518	2.03
0.0521	2.13
0.0523	2.11
0.0525	1.89
0.0527	1.74
0.0529	1.69
0.0532	1.67
0.0536	1.68
0.0539	1.71
0.0541	1.81
0.0543	1.88
0.0546	1.92
0.0548	1.93
0.0551	1.92
0.0558	1.82
0.0563	1.56
0.0568	1.53
0.0574	1.50
0.0582	1.48
0.0590	1.45
0.0596	1.43
0.0601	1.41
0.0604	1.40
0.0607	1.40
0.0613	1.40
0.0616	1.41
0.0620	1.43
0.0626	1.44
0.0629	1.44
0.0632	1.43
0.0635	1.44
0.0642	1.45
0.0645	1.45
0.0652	1.43

λ	n
DATA SET 6 (CONT.)	
0.0659	1.42
0.0670	1.39
0.0681	1.36
0.0688	1.33
0.0696	1.32
0.0700	1.31
0.0704	1.33
0.0708	1.36
0.0712	1.39
0.0720	1.41
0.0729	1.43
0.0738	1.45
0.0746	1.49
0.0756	1.55
0.0765	1.59
0.0770	1.65
0.0779	1.79
0.0784	1.83
0.0789	1.78
0.0794	1.71
0.0800	1.69
0.0805	1.71
0.0810	1.76
0.0815	1.66
0.0826	1.54
0.0837	1.46
0.0843	1.45
0.0849	1.47
0.0855	1.49
0.0861	1.52
0.0867	1.58
0.0873	1.65
0.0879	1.72
0.0885	1.81
0.0892	1.98
0.0898	2.07
0.0905	2.15
0.0911	2.23
0.0918	2.24
0.0925	2.25

TABLE 20. EXPERIMENTAL REFRACTIVE INDEX OF STRONTIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n)

λ	n
DATA SET 6(CONT.)	
0.0932	2.25
0.0939	2.23
0.0946	2.20
0.0953	2.15
0.0960	2.08
0.0976	2.00
0.0984	1.88
0.0992	1.82
0.1000	1.72
0.1008	1.68
0.1016	1.78
0.1024	1.90
0.1033	2.07
0.1042	2.10
0.1050	2.06
0.1059	2.02
0.1078	2.00
0.1087	1.98
0.1097	1.92
0.1117	1.84
0.1127	1.76
0.1137	1.66
0.1148	1.54
0.1158	1.64
0.1169	1.95
0.1180	2.17
0.1192	2.33
0.1203	2.45
0.1215	2.38
0.1227	2.34
0.1240	2.31
DATA SET 7	
T = 300.0	
0.0580	0.69
0.0591	0.74
0.0607	0.75
0.0614	0.71
0.0668	0.82

λ	n
DATA SET 7(CONT.)	
0.0695	0.82
0.0710	0.77
0.0754	0.77
0.0816	0.92
0.0931	1.02
0.0857	0.84
0.0870	0.79
0.0899	0.87
0.0933	1.14
0.0961	1.30
0.0988	1.25
0.1014	1.15
0.1030	1.28
0.1058	1.58
0.1088	1.94
0.1110	2.06
0.1128	2.01
0.1128	1.40
0.1135	1.31
0.1157	1.39
0.1172	1.59
0.1172	2.66
0.1184	2.70
0.1209	2.66
0.1298	2.01
0.1364	1.78
0.1470	1.67
0.1691	1.57
0.1943	1.52
0.2254	1.48
0.2655	1.46
0.3139	1.43
0.4460	1.43
DATA SET 8	
T = 293.0	
4.0	1.44
10.0	1.36

λ	n
DATA SET 9	
T = 293.0	
0.37	1.455
0.42	1.444
0.44	1.442
0.49	1.440
0.55	1.438
0.60	1.437
0.69	1.435
0.83	1.434
1.00	1.432
1.50	1.429
2.00	1.425
2.50	1.421
3.00	1.416
3.50	1.412
4.00	1.409
4.50	1.406
5.00	1.400
5.50	1.397
6.00	1.393
6.50	1.389
7.00	1.386
7.50	1.381
8.00	1.377
8.50	1.373
9.00	1.369
9.50	1.365
10.00	1.362

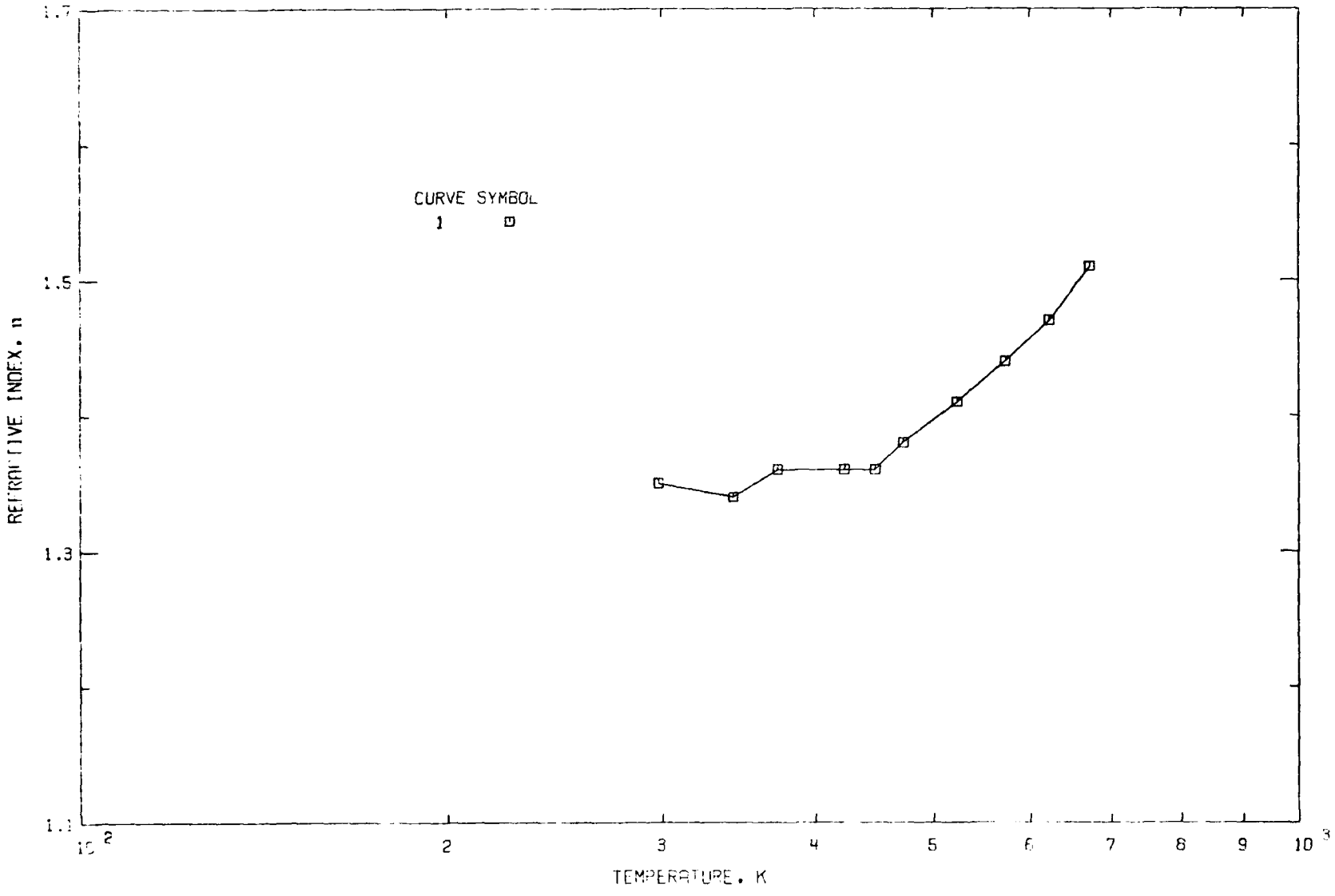


FIGURE 14. REFRACTIVE INDEX OF STRONTIUM FLUORIDE (TEMPERATURE DEPENDENCE).

TABLE 21. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF STRONTIUM FLUORIDE (TEMPERATURE DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	64	GISIN, M.A.	1969	I	4.5	298-673	THIN FILM SPECIMEN OF 0.7 TO 0.86 MICROMETER ON SILICON OR GERMANIUM SUBSTRATE; REFRACTIVE INDEX DETERMINED BY INTERFERENCE METHOD FOR THE SPECTRAL LINE 4.5 MICROMETERS; DATA EXTRACTED FROM A TABLE.

TABLE 22. EXPERIMENTAL REFRACTIVE INDEX OF STRONTIUM FLUORIDE (TEMPERATURE DEPENDENCE)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n)

T	n
DATA SET 1	
λ = 4.5	
298.0	1.35
343.0	1.34
373.0	1.36
423.0	1.36
448.0	1.36
473.0	1.38
523.0	1.41
573.0	1.44
623.0	1.47
673.0	1.51

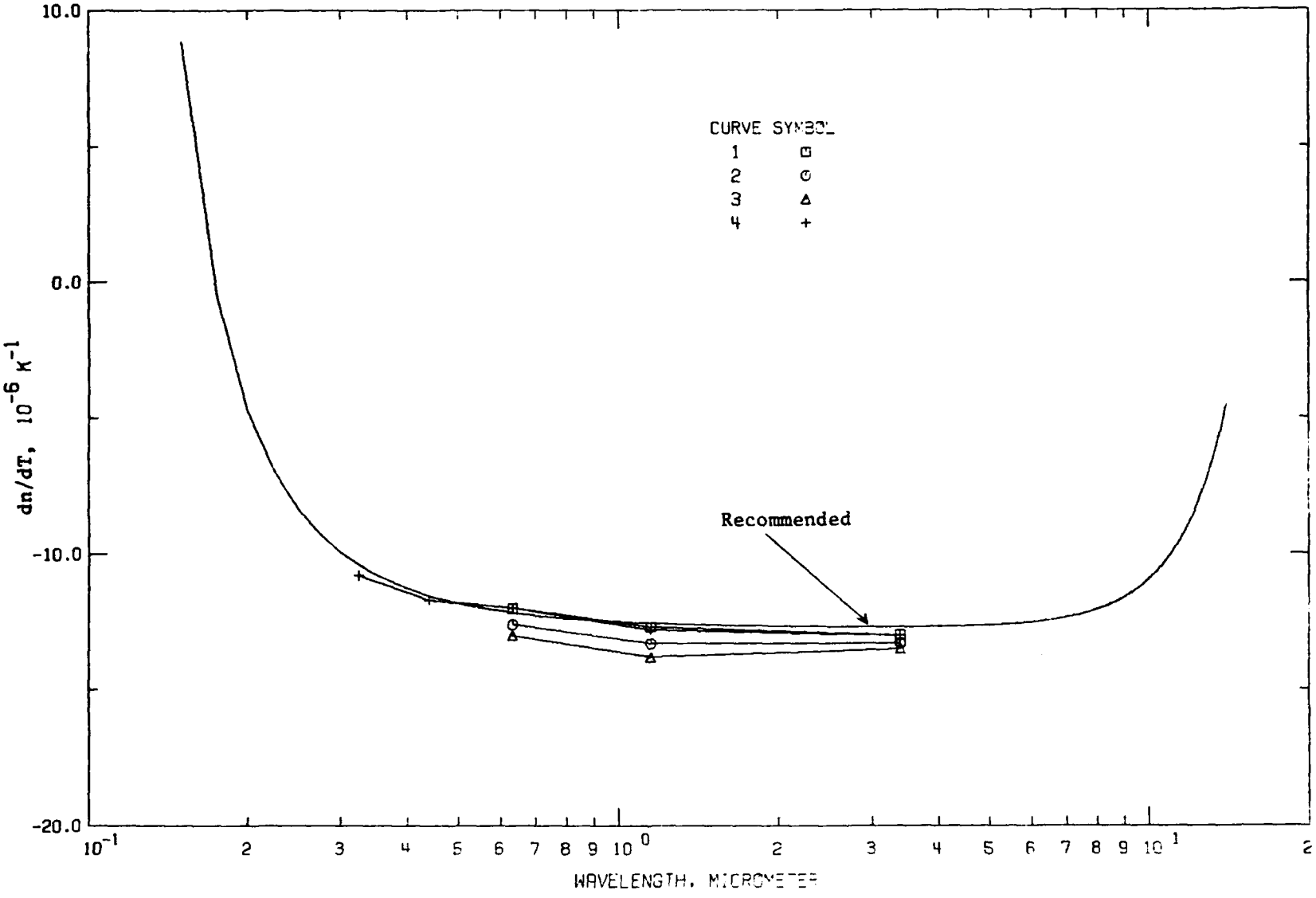


FIGURE 15. TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF STRONTIUM FLUORIDE (WAVELENGTH DEPENDENCE).

TABLE 23. MEASUREMENT INFORMATION ON THE TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF STRONTIUM FLUORIDE (WAVELENGTH DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	59	LIPSON,H.G. TSAY,Y.F. BENDOW,B LIGOR,P.A.	1976	I	0.63-3.39	310	SINGLE CRYSTAL; DISC SPECIMEN; 1.90CM DIAMETER, 1CM TO 2.50M THICK; DN/DT DETERMINED FOR 3 SPECTRAL LINES BY OBSERVING THE INTERFERENCE FRINGE CHANGES AND THE CORRESPONDING TEMPERATURE CHANGES; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF DN/DT ABOUT $0.6 \times 10^{-6} K^{-1}$.
2	59	LIPSON,H.G. ET AL.	1976	I	0.63-3.39	330	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 330K; UNCERTAINTY OF DN/DT $0.6 \times 10^{-6} K^{-1}$.
3	59	LIPSON,H.G. ET AL.	1976	I	0.63-3.39	350	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 350K; UNCERTAINTY OF DN/DT $0.5 \times 10^{-6} K^{-1}$.
4	92	TSAY,Y.F. LIPSON,H.G. LIGOR,P.A.	1977	I	0.32-3.39	310	SINGLE CRYSTAL; DISC SPECIMEN; 1.90CM DIAMETER, 1.27CM THICK; DN/DT DETERMINED BY OBSERVING THE INTERFERENCE FRINGE CHANGES AND THE CORRESPONDING TEMPERATURE CHANGES DATA EXTRACTED FROM A FIGURE; UNCERTAINTY OF DN/DT ABOUT $1.0 \times 10^{-6} K^{-1}$.

TABLE 24. EXPERIMENTAL TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF STRONTIUM FLUORIDE (WAVELENGTH DEPENDENCE)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX , dn/dT, 10^{-6} K^{-1})

λ	dn/dT
DATA SET 1	
T = 310.0	
0.6328	-12.0
1.15	-12.7
3.39	-13.0
DATA SET 2	
T = 330.0	
0.6328	-12.6
1.15	-13.3
3.39	-13.3
DATA SET 3	
T = 350.0	
0.6328	-13.0
1.15	-13.0
3.39	-13.5
DATA SET 4	
T = 310.0	
0.325	-10.8
0.4416	-11.7
0.6328	-12.0
1.15	-12.6
3.39	-13.0

TABLE 25. COMPARISON OF DISPERSION EQUATIONS PROPOSED FOR SrF_2

Source	Wavelength and Temperature Ranges	Dispersion Equation λ in μm; ν in cm^{-1}
Kaiser, W., Spitzer, W.G., Kaiser, R.H., and Howarth, L.E. 1962	10-80 μm 293 K	$n^2 - k^2 = \epsilon_\infty + \sum_i 4\pi\rho_i \nu_i^2 \frac{\nu_i^2 - \nu^2}{(\nu_i^2 - \nu^2)^2 + \gamma_i^2 \nu^2 \nu_i^2}$ $2nk = \sum_i 4\pi\rho_i \nu_i^2 \frac{\gamma_i \nu \nu_i}{(\nu_i^2 - \nu^2)^2 + \gamma_i^2 \nu^2 \nu_i^2}$ *
Present work 1977	0.15-14.0 μm 293 K	$n^2 = 1.33973 + \frac{0.720\lambda^2}{\lambda^2 - (0.09566)^2} + \frac{0.066\lambda^2}{\lambda^2 - (26.03)^2} + \frac{3.94\lambda^2}{\lambda^2 - (45.60)^2}$

* $i = 1, 2$; $4\pi\rho_1 = 4.00$, $4\pi\rho_2 = 0.07$; $\nu_1 = 217\ cm^{-1}$, $\nu_2 = 318\ cm^{-1}$; $\gamma_1 = 0.017$, $\gamma_2 = 0.25$.

3.3 Barium Fluoride, BaF_2

Barium fluoride is transparent in a wide spectral range from 0.14 up to 15 micrometers. The transmittance of a BaF_2 plate 2.3 mm thick increases rapidly from a sharp cutoff at 0.1345 micrometer to 85 percent at 0.4 micrometer and continues at that level to about 10 micrometers, after which it falls off rapidly. The observed transmittance at longer wavelength varys with the thickness of the sample. For a plate 10 mm thick, the transmittance is 50 percent at 11.7 micrometers and 10 percent at 13.5 micrometers while 60 percent transmittance at 15 micrometers can be obtained for a 3.5 mm plate. Because of its uniform transparency in the spectral region 0.4 to 10 micrometers, barium fluoride is used for window and lens fabrication. As the laser technology advances, the need for optical material with high optical figure of merit and adequate mechanical properties is increasing. Barium fluoride, having the required advantages, is among the serious candidates for window materials for the spectral region between 2 to 6 micrometers.

Unlike calcium fluoride, which occurs naturally in large sizes and of optical quality, barium fluoride crystal for optical applications is synthesized. As a result, early investigations of optical properties did not include barium fluoride. The earliest measurements of the refractive index were probably made by Wulff [66] in 1928 and by Wulff and Heigl [62] in 1931, using the immersion method for the mean of the sodium D lines. The

sample they used was in small fragments produced by chemical reaction.

Synthetic barium fluoride crystals of optical quality were successfully grown by Stockbarger during World War II. In the 1950's synthetic BaF_2 crystals became available commercially and found acceptance because of their favorable physical characteristics and broad transparent range. BaF_2 transmits further into the infrared than does either CaF_2 or LiF. However, until 1963, the refractive index data of BaF_2 were reported only by Houston et al. [47] for the spectral range 0.54 to 1.85 micrometers. Data on the refractive index over a wide spectral range were reported by Malitson [67] in 1964, for the region from 0.26 up to 10.4 micrometers, and have served as the reference data since then. As a matter of fact, Malitson's data is the only available set that covers the whole transparent region and is reliable enough to bethe basis of data analysis.

Kaiser et al. [17] investigated the reflection spectrum of BaF_2 in the reststrahlen region from 10 to 80 micrometers. Refractive and absorption indices were deduced from the analysis of the reflection spectrum by lorentz oscillator theory. The strong resonance at 54.3 micrometers was identified as the optically active TO resonance. A second resonance about one order of magnitude weaker than the main resonance is at 36 micrometers. The origin of the weaker absorption was unkown, and Kaiser proposed the possibility of a two-phonon combination band

involving the TO mode. However, this weak absorption does not appear in Lowndes' work [15], in which the reflection spectrum was reduced by Kramers-Kronig analysis. Instead of the weak resonance at 36 micrometers, Lowndes obtained a weak absorption at 29.07 micrometers, which was identified as the longitudinal optical resonance, LO mode. Since Lowndes may have used a purer sample than that used by Kaiser, it is likely that the weak absorption at 36 micrometers is due to impurities in Kaiser's sample.

In the vacuum ultraviolet region, Fabre et al. [49] investigated the spectral region from 0.1 to 0.162 micrometer by Kramers-Kronig analysis of the reflection spectrum, and found a strong absorption peak at 0.122 micrometer, the lower limit of the transparency of BaF_2. Nisar et al. [25] studied the reflection spectrum in the energy range 8-35 eV and disclosed the complication of absorption beyond the lower transparent limit. Similar observations were carried out by Ganin et al. [53] and Rubloff [24].

From the brief review of available data, it is clear that Malitson's data is the only choice for the basis of data analysis. The problem is to find appropriate input parameters for the dispersion equation. Malitson determined refractive indices for 46 spectral lines, and the values were mathematically fitted to a Sellmeier dispersion equation as given in table 35, where dispersion equations proposed by others are also listed for

comparisons.

The high frequency dielectric constant indicated by Malitson's dispersion equation is 2.15, in good agreement with those from other sources. However, the static dielectric constant calculated from his dispersion equation is 5.976, which is substantially lower than the experimental value, 7.36. This large difference can be ascribed to the low value of the infrared resonant wavelength used in his equation. The resonant wavelength resulting from his best fit is 46.39 micrometers, while the accepted value derived from the infrared reflection spectrum by Lowndes [15] is 53.33 micrometers. In the transparent region, the contribution to the refractive index from the infrared term is negative. For a given set of refractive index data, the coefficient, which in turn is connected to the static dielectric constant, depends on the resonant wavelength in the term: the longer the wavelength, the higher the coefficient. It is therefore possible to obtain a proper combination of these two parameters to yield a good fit to the experimental data, but with each parameter in the term having appropriate physical meaning. To this end, proper selection of input parameters is essential.

as in the case of CaF_2, the Sellmeier formula for BaF_2 consists of a constant, a term giving the UV contribution and two terms giving the infrared contribution. The values of the constant, the coefficient of the UV term and the corresponding

effective wavelength of the UV absorption band can be determined by data fitting. However, the coefficient and absorption band wavelength for each of the infrared terms cannot be determined in such a way; one must know one or the other of the parameters because the dispersion of available data values at long wavelengths is not high enough for a unique determination of both parameters. It is fortunate that the wavelengths of the absorption bands are available and well determined. From table 6, the average room-temperature wavelengths of TO and LO optical phonons are respectively 53.82 and 29.87 micrometers. The result of a least squares calculation is the dispersion equation for BaF_2 at 293 K in the transparent region, 0.15-15 micrometers,

$$n^2 = 1.33973 + \frac{0.81070\,\lambda^2}{\lambda^2 - 0.10065^2} + \frac{0.19652\,\lambda^2}{\lambda^2 - 29.87^2} + \frac{4.52469\,\lambda^2}{\lambda^2 - 53.82^2}, \qquad (21)$$

where λ is in micrometers.

This dispersion equation closely fits Malitson's data with a root mean square residual of 2.0×10^{-5} in the spectral region from 0.26 to 10.35 micrometers. Although the use of this equation can be confidently extended into the infrared un to 15 micrometer, its use in the UV region beyond 0.26 micrometers is not recommended, because the value of λ_u is determined by fitting of the available data at wavelengths longer than 0.26 micrometer; in the range from 0.15 to 0.26 micrometer, larger uncertainties must be expected. The upper limit of the uncertainties can be estimated by differentiating eq (21) with respect to λ_u:

$$\Delta n = \frac{0.81070\,\lambda^2}{(\lambda^2 - \lambda_u^2)^2}\left(\frac{\lambda_u\,\Delta\lambda_u}{n}\right), \qquad (22)$$

where $\Delta\lambda_u = 0.122 - \lambda_u$.

The optical dielectric constant indicated by eq (21) is 2.15042, which agrees with that from other work. The static dielectric constant implied by this equation is 6.472, about 0.5 less than Andeen's value (see table 5). There are many causes for the discrepancy. Two of the essential ones are that (i) we have ignored small contributions from many absorption bands in the infrared region beyond the predominant phonons; (ii) we have neglected the damping factors in the dispersion equation. Neglecting the damping factors tends to reduce the value of the static dielectric constant.

With regard to the temperature derivative of the refractive index of barium fluoride, little work has been done. Although Malitson [67] also measured refractive indices for 46 wavelengths from 0.26 to 10.35 micrometers at room temperatures in the neighborhood of 288 K and 303 K, the results could not be used to evaluate dn/dT because of excessive fluctuations; only tentative averaged values of dn/dT were given. He found that dn/dT is negative over the entire measured wavelength range. There is evidence that the value of dn/dT (in units of $10^{-6}K^{-1}$) ranges from an average of about -11 in the near ultraviolet to -15 in the visible and to a low of about -17 in the near infrared; then it increases to an average of -9 at the long wavelength limit. However, more accurate values were given for visible regions from

0.4 to 0.77 micrometer, based on the observations carried out in 1944 and reported in Malitson's 1963 work. Other dn/dT measurements were resently made by Lipson et al. [59], Harris et al. [60] and Tsay et al. [92]. They used the interference method to obtain dn/dT directly by observing the shift of interference fringes with temperature. This method is believed to yield accurate dn/dT values, but measurements were made only at five wavelenghts, 0.325, 0.4416, 0.6328, 1.15 and 3.39 micrometers. Data on dn/dT remains scarce. With the limited data, the generation of probable values for the entire transparent region depends heavily on the selection of input parameters and appropriate determination of the coefficients. As in the case of CaF_2, we use Malitson's dn/dT values in the 0.4 to 0.77 micrometer region to determine the coefficients of the constant and ultraviolet terms, assuming that the contribution from infrared terms is negligible. This assumption is a good approximation because the contribution of the infrared term to the visible region is at most less than 0.1 (in units of 10^{-6} K^{-1}) while the value of dn/dT is about -15. Then by holding the constant and ultraviolet terms fixed, one can evaluate the coefficients of the infrared terms using dn/dT values of Lipson, Harris, and Tsay. The following equation was found to represent dn/dT of Ba F_2 for the transparent region, at 293 K:

$$2n\frac{dn}{dT} = -8.18 - 59.4(n^2 - 1) + \frac{31.0\,\lambda^4}{(\lambda^2 - 0.1036^2)^2} + \frac{225.0\,\lambda^2}{\lambda^2 - 53.82^2} + \frac{1660.8\,\lambda^4}{(\lambda^2 - 53.82^2)^2}, \quad (23)$$

where dn/dT and λ are in units of 10^{-6} K^{-1} and micrometers respectively.

The variation of dn/dT with temperature has been observed by Houston et al. [47], Selezneva [88], Lipson et al. [59] and Tsay et al. [92]. The measurement information and results of their work are given in tables 33 and 34, and are plotted in figure 18, where we see that such observations are limited at five visible wavelengths. The magnitude of dn/dT is found to increase slightly with temperature. The possible origin of this increase was discussed by Lipson, and Tsay, who concluded that the temperature dependence of dn/dT arises mainly from that of the thermal expansion coefficient, α. However, the relation between the dn/dT variation with temperature and the thermal expansion coefficient has not yet been established for general applications because it varies very much with wavelength. For the time being the application of eq (4) to evaluate dn/dT only at temperatures not far from 293K is recommended.

Equations (21) and (23) were used to generate the reference data given in the table of recommended values. The values of $dn/d\lambda$ were simply evaluated by the first derivative of eq (21). Although the values of n are given to the fifth decimal place and dn/dT to the first, this does not reflect their accuracy and reliability. They are so given simply for smoothness of tabulation. For the proper use of the tabulated values the reader should follow the criteria given below.

For refractive index:

Wavelength range micrometer	Estimated uncertainty.*
0.15-0.20	0.001
0.20-0.30	0.0005
0.30-0.40	0.0003
0.40-10.0	0.0001
10.0-12.0	0.0003
12.0-15.0	0.001

For dn/dT:

0.15-0.20	3.0
0.20-0.30	2.0
0.30-1.0	1.0
1.0-6.0	0.5
6.0-10.0	1.0
10.0-15.0	1.5

TABLE 26. RECOMMENDED VALUES ON THE REFRACTIVE INDEX AND ITS WAVELENGTH AND TEMPERATURE DERIVATIVES FOR BARIUM FLUORIDE AT 293K*

λ μm	n	-dn/dλ μm⁻¹	dn/dT 10⁻⁶ K⁻¹	λ μm	n	-dn/dλ μm⁻¹	dn/dT 10⁻⁶ K⁻¹	λ μm	n	-dn/dλ μm⁻¹	dn/dT 10⁻⁶ K⁻¹
0.150	1.67760	4.79950	-0.8	0.270	1.51034	0.37295	-13.8	0.700	1.47196	0.01781	-15.3
0.152	1.66816	4.46568	-1.9	0.272	1.50941	0.36325	-13.8	0.720	1.47162	0.01643	-15.3
0.154	1.65979	4.18473	-2.7	0.274	1.50849	0.35390	-13.9	0.740	1.47130	0.01520	-15.3
0.156	1.65192	3.94370	-3.5	0.276	1.50819	0.34488	-13.9	0.760	1.47101	0.01410	-15.4
0.158	1.64440	3.58647	-4.3	0.278	1.50751	0.33617	-13.9	0.780	1.47074	0.01311	-15.4
0.160	1.63746	3.35353	-4.9	0.280	1.50685	0.32776	-14.0	0.800	1.47049	0.01223	-15.4
0.162	1.63097	3.14194	-5.5	0.282	1.50620	0.31965	-14.0	0.820	1.47025	0.01144	-15.4
0.164	1.62489	2.94917	-6.1	0.284	1.50557	0.31180	-14.0	0.840	1.47003	0.01072	-15.4
0.166	1.61915	2.77336	-6.6	0.286	1.50495	0.30422	-14.0	0.860	1.46982	0.01007	-15.4
0.168	1.61374	2.61117	-7.1	0.288	1.50435	0.29690	-14.1	0.880	1.46962	0.00949	-15.4
0.170	1.60871	2.46368	-7.5	0.290	1.50376	0.28981	-14.1	0.900	1.46944	0.00895	-15.4
0.172	1.60392	2.32740	-7.9	0.292	1.50319	0.28296	-14.1	0.920	1.46927	0.00847	-15.4
0.174	1.59939	2.20172	-8.2	0.294	1.50263	0.27632	-14.1	0.940	1.46910	0.00803	-15.4
0.176	1.59510	2.08557	-8.6	0.296	1.50209	0.26990	-14.2	0.960	1.46894	0.00763	-15.4
0.178	1.59104	1.97802	-8.9	0.298	1.50155	0.26369	-14.2	0.980	1.46880	0.00726	-15.4
0.180	1.58719	1.87926	-9.2	0.300	1.50103	0.25767	-14.2	1.000	1.46865	0.00692	-15.4
0.182	1.58352	1.78555	-9.4	0.305	1.49978	0.24342	-14.3	1.050	1.46833	0.00620	-15.4
0.184	1.58004	1.69925	-9.7	0.310	1.49860	0.23024	-14.3	1.100	1.46803	0.00561	-15.4
0.186	1.57672	1.61879	-9.9	0.315	1.49748	0.21801	-14.4	1.150	1.46776	0.00513	-15.4
0.188	1.57356	1.54366	-10.1	0.320	1.49641	0.20667	-14.4	1.200	1.46752	0.00474	-15.5
0.190	1.57054	1.47341	-10.4	0.325	1.49541	0.19612	-14.4	1.250	1.46729	0.00442	-15.5
0.192	1.56766	1.40763	-10.5	0.330	1.49445	0.18629	-14.5	1.300	1.46707	0.00416	-15.5
0.194	1.56491	1.34595	-10.7	0.335	1.49354	0.17713	-14.5	1.350	1.46687	0.00394	-15.5
0.196	1.56228	1.28804	-10.9	0.340	1.49268	0.16857	-14.6	1.400	1.46668	0.00377	-15.5
0.198	1.55976	1.23361	-11.1	0.345	1.49186	0.16058	-14.6	1.450	1.46649	0.00362	-15.5
0.200	1.55734	1.18239	-11.2	0.350	1.49107	0.15309	-14.6	1.500	1.46632	0.00350	-15.5
0.202	1.55503	1.13413	-11.4	0.355	1.49033	0.14607	-14.7	1.550	1.46614	0.00341	-15.5
0.204	1.55280	1.08861	-11.5	0.360	1.48961	0.13949	-14.7	1.600	1.46598	0.00333	-15.5
0.206	1.55067	1.04563	-11.6	0.365	1.48893	0.13331	-14.7	1.650	1.46581	0.00327	-15.5
0.208	1.54862	1.00502	-11.8	0.370	1.48828	0.12749	-14.7	1.700	1.46565	0.00322	-15.5
0.210	1.54665	0.96659	-11.9	0.375	1.48765	0.12202	-14.8	1.750	1.46549	0.00319	-15.5
0.212	1.54475	0.93021	-12.0	0.380	1.48706	0.11687	-14.8	1.800	1.46533	0.00316	-15.5
0.214	1.54293	0.89573	-12.1	0.385	1.48648	0.11200	-14.8	1.850	1.46517	0.00315	-15.5
0.216	1.54117	0.86302	-12.2	0.390	1.48594	0.10741	-14.9	1.900	1.46501	0.00314	-15.5
0.218	1.53947	0.83197	-12.3	0.395	1.48541	0.10308	-14.8	1.950	1.46486	0.00314	-15.5
0.220	1.53784	0.80247	-12.4	0.400	1.48491	0.09898	-14.9	2.000	1.46470	0.00315	-15.5
0.222	1.53626	0.77442	-12.5	0.410	1.48395	0.09142	-14.9	2.050	1.46454	0.00316	-15.5
0.224	1.53474	0.74773	-12.6	0.420	1.48307	0.08463	-14.9	2.100	1.46438	0.00317	-15.5
0.226	1.53327	0.72231	-12.6	0.430	1.48226	0.07852	-15.0	2.150	1.46423	0.00319	-15.5
0.228	1.53185	0.69809	-12.7	0.440	1.48150	0.07299	-15.0	2.200	1.46406	0.00322	-15.5
0.230	1.53048	0.67498	-12.8	0.450	1.48080	0.06798	-15.0	2.250	1.46390	0.00325	-15.5
0.232	1.52915	0.65294	-12.9	0.460	1.48014	0.06344	-15.0	2.300	1.46374	0.00328	-15.5
0.234	1.52786	0.63189	-12.9	0.470	1.47953	0.05929	-15.1	2.350	1.46358	0.00331	-15.5
0.236	1.52662	0.61177	-13.0	0.480	1.47895	0.05552	-15.1	2.400	1.46341	0.00335	-15.5
0.238	1.52542	0.59254	-13.1	0.490	1.47842	0.05206	-15.1	2.450	1.46324	0.00338	-15.5
0.240	1.52425	0.57415	-13.1	0.500	1.47791	0.04889	-15.1	2.500	1.46307	0.00342	-15.5
0.242	1.52312	0.55654	-13.2	0.510	1.47744	0.04599	-15.1	2.550	1.46290	0.00346	-15.5
0.244	1.52202	0.53968	-13.2	0.520	1.47699	0.04331	-15.2	2.600	1.46272	0.00351	-15.5
0.246	1.52096	0.52352	-13.3	0.530	1.47657	0.04085	-15.2	2.650	1.46255	0.00355	-15.5
0.248	1.51993	0.50803	-13.3	0.540	1.47617	0.03857	-15.2	2.700	1.46237	0.00360	-15.5
0.250	1.51893	0.49316	-13.4	0.550	1.47580	0.03647	-15.2	2.750	1.46219	0.00365	-15.5
0.252	1.51796	0.47889	-13.4	0.560	1.47544	0.03452	-15.2	2.800	1.46200	0.00369	-15.5
0.254	1.51701	0.46520	-13.5	0.570	1.47511	0.03272	-15.2	2.850	1.46182	0.00374	-15.5
0.256	1.51609	0.45205	-13.5	0.580	1.47479	0.03104	-15.2	2.900	1.46163	0.00379	-15.5
0.258	1.51520	0.43940	-13.6	0.590	1.47449	0.02948	-15.2	2.950	1.46144	0.00384	-15.5
0.260	1.51434	0.42724	-13.6	0.600	1.47420	0.02803	-15.3	3.000	1.46125	0.00390	-15.5
0.262	1.51351	0.41554	-13.6	0.620	1.47366	0.02542	-15.3	3.050	1.46105	0.00395	-15.5
0.264	1.51267	0.40429	-13.7	0.640	1.47318	0.02313	-15.3	3.100	1.46085	0.00400	-15.5
0.266	1.51188	0.39345	-13.7	0.660	1.47274	0.02113	-15.3	3.150	1.46065	0.00406	-15.5
0.268	1.51110	0.38301	-13.8	0.680	1.47233	0.01937	-15.3	3.200	1.46044	0.00411	-15.5

TABLE 26. RECOMMENDED VALUES ON THE REFRACTIVE INDEX AND ITS WAVELENGTH AND TEMPERATURE DERIVATIVES FOR BARIUM FLUORIDE AT 293K (CONTINUED)*

λ μm	n	-dn/dλ μm⁻¹	dn/dT 10⁻⁶ K⁻¹	λ μm	n	-dn/dλ μm⁻¹	dn/dT 10⁻⁶ K⁻¹	λ μm	n	-dn/dλ μm⁻¹	dn/dT 10⁻⁶ K⁻¹
3.250	1.46024	0.00417	-15.5	5.200	1.44991	0.00659	-15.4	8.900	1.41569	0.01206	-14.8
3.300	1.46001	0.00422	-15.5	5.300	1.44915	0.00672	-15.4	9.000	1.41448	0.01222	-14.7
3.350	1.45982	0.00428	-15.5	5.400	1.44842	0.00686	-15.4	9.100	1.41324	0.01239	-14.7
3.400	1.45960	0.00434	-15.5	5.500	1.44768	0.00699	-15.4	9.200	1.41200	0.01256	-14.7
3.450	1.45938	0.00440	-15.5	5.600	1.44707	0.00713	-15.3	9.300	1.41073	0.01273	-14.7
3.500	1.45916	0.00445	-15.5	5.700	1.44635	0.00726	-15.3	9.400	1.40945	0.01290	-14.6
3.550	1.45894	0.00451	-15.5	5.800	1.44562	0.00740	-15.3	9.500	1.40815	0.01307	-14.6
3.600	1.45871	0.00457	-15.5	5.900	1.44487	0.00754	-15.3	9.600	1.40684	0.01325	-14.5
3.650	1.45848	0.00463	-15.5	6.000	1.44411	0.00767	-15.3	9.700	1.40550	0.01342	-14.5
3.700	1.45825	0.00469	-15.5	6.100	1.44334	0.00781	-15.3	9.800	1.40415	0.01360	-14.5
3.750	1.45801	0.00475	-15.5	6.200	1.44255	0.00795	-15.3	9.900	1.40278	0.01378	-14.4
3.800	1.45777	0.00481	-15.5	6.300	1.44174	0.00809	-15.3	10.000	1.40140	0.01396	-14.4
3.850	1.45753	0.00487	-15.4	6.400	1.44093	0.00824	-15.3	10.200	1.39857	0.01432	-14.3
3.900	1.45728	0.00493	-15.4	6.500	1.44010	0.00838	-15.2	10.400	1.39567	0.01469	-14.2
3.950	1.45704	0.00499	-15.4	6.600	1.43925	0.00852	-15.2	10.600	1.39269	0.01507	-14.1
4.000	1.45679	0.00505	-15.4	6.700	1.43839	0.00866	-15.2	10.800	1.38964	0.01545	-14.0
4.050	1.45653	0.00511	-15.4	6.800	1.43752	0.00881	-15.2	11.000	1.38651	0.01584	-13.9
4.100	1.45627	0.00518	-15.4	6.900	1.43663	0.00895	-15.2	11.200	1.38330	0.01624	-13.8
4.150	1.45601	0.00524	-15.4	7.000	1.43573	0.00910	-15.2	11.400	1.38002	0.01664	-13.7
4.200	1.45575	0.00530	-15.4	7.100	1.43481	0.00925	-15.2	11.600	1.37665	0.01705	-13.6
4.250	1.45548	0.00536	-15.4	7.200	1.43388	0.00939	-15.1	11.800	1.37319	0.01747	-13.4
4.300	1.45521	0.00543	-15.4	7.300	1.43293	0.00954	-15.1	12.000	1.36966	0.01790	-13.3
4.350	1.45494	0.00549	-15.4	7.400	1.43197	0.00969	-15.1	12.200	1.36603	0.01834	-13.2
4.400	1.45467	0.00555	-15.4	7.500	1.43099	0.00984	-15.1	12.400	1.36232	0.01879	-13.0
4.450	1.45439	0.00561	-15.4	7.600	1.43000	0.00999	-15.1	12.600	1.35852	0.01924	-12.8
4.500	1.45410	0.00568	-15.4	7.700	1.42900	0.01015	-15.1	12.800	1.35462	0.01971	-12.7
4.550	1.45382	0.00574	-15.4	7.800	1.42797	0.01030	-15.0	13.000	1.35063	0.02019	-12.5
4.600	1.45353	0.00581	-15.4	7.900	1.42694	0.01045	-15.0	13.200	1.34655	0.02067	-12.3
4.650	1.45324	0.00587	-15.4	8.000	1.42588	0.01061	-15.0	13.400	1.34236	0.02117	-12.1
4.700	1.45294	0.00593	-15.4	8.100	1.42481	0.01077	-15.0	13.600	1.33808	0.02168	-11.9
4.750	1.45264	0.00600	-15.4	8.200	1.42373	0.01092	-15.0	13.800	1.33369	0.02220	-11.6
4.800	1.45234	0.00606	-15.4	8.300	1.42263	0.01108	-14.9	14.000	1.32920	0.02274	-11.4
4.850	1.45204	0.00613	-15.4	8.400	1.42151	0.01124	-14.9	14.200	1.32459	0.02329	-11.1
4.900	1.45173	0.00619	-15.4	8.500	1.42038	0.01140	-14.9	14.400	1.31988	0.02385	-10.9
4.950	1.45142	0.00626	-15.4	8.600	1.41923	0.01156	-14.9	14.600	1.31505	0.02443	-10.6
5.000	1.45110	0.00633	-15.4	8.700	1.41807	0.01173	-14.8	14.800	1.31011	0.02502	-10.3
5.100	1.45046	0.00646	-15.4	8.800	1.41689	0.01189	-14.8	15.000	1.30504	0.02563	-10.0

* IN THIS TABLE MORE DECIMAL PLACES ARE REPORTED THAN WARRANTED MERELY FOR THE PURPOSE OF TABULAR SMOOTHNESS AND INTERNAL COMPARISON. FOR UNCERTAINTIES OF TABULATED VALUES IN VARIOUS WAVELENGTH RANGES, SEE THE TEXT OF SUBSECTION 3.3.

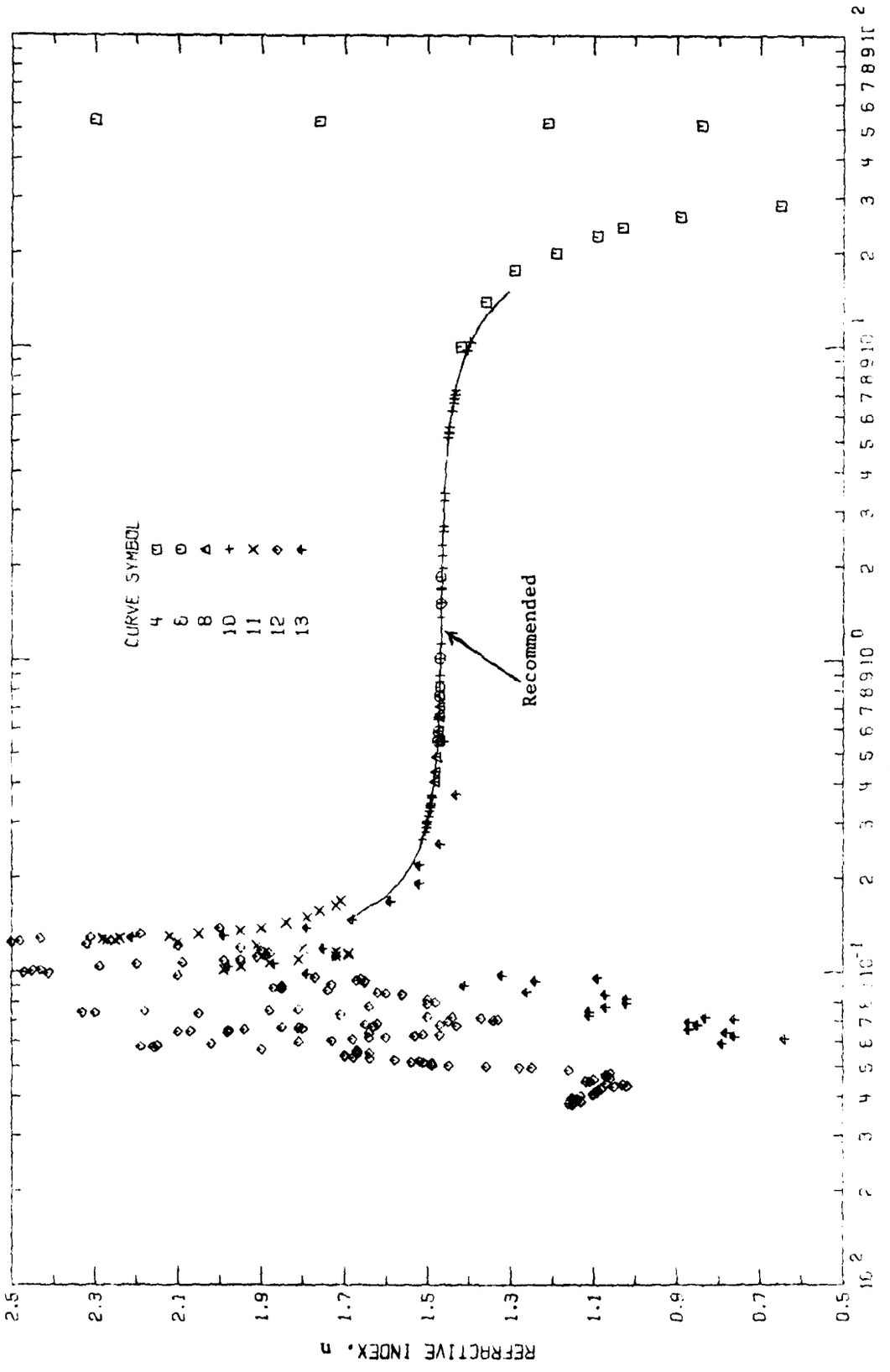


FIGURE 11. REFRACTIVE INDEX OF BARIUM FLUORIDE (WAVELENGTH REFERENCED)

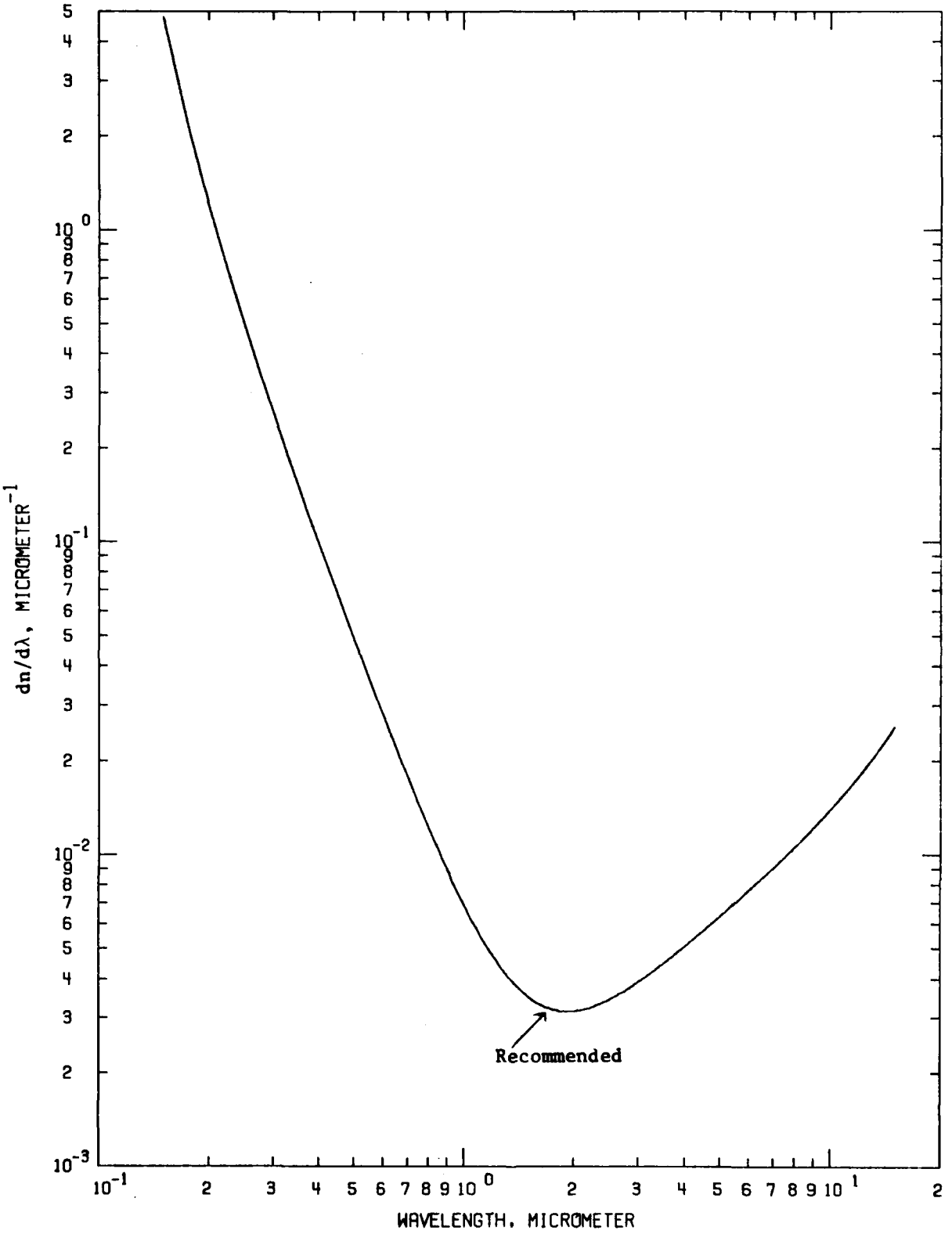


FIGURE 17. WAVELENGTH DERIVATIVE OF REFRACTIVE INDEX OF BARIUM FLUORIDE.

TABLE 27. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF BARIUM FLUORIDE (WAVELENGTH DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	61	THILO,F.	1927	M	0.589	293	SINGLE CRYSTAL; REFRACTIVE INDEX DETERMINED BY IMMERSION METHOD FOR THE MEAN OF SODIUM D LINES; DATA EXTRACTED FROM A TABLE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
2	66	WULFF,P.	1928	M	0.589	298	CRYSTAL OF UNSPECIFIED TYPE; REFRACTIVE INDEX DETERMINED BY IMMERSION METHOD FOR THE MEAN OF SODIUM D LINES; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF INDEX 0.00010.
3	62	WULFF,P. MEIGL,A.	1931	M	0.589	298	SINGLE CRYSTAL; 1-2 MM FRAGMENTS; OBTAINED FROM COOLING THE MELT; REFRACTIVE INDEX DETERMINED BY IMMERSION METHOD FOR THE MEAN OF SODIUM D LINES; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF INDEX 0.0002.
4	17	KAISER,W. SPITZER,W.G. KAISER,R.H. HOWARTH,L.E.	1962	R	10.0-80.0	300	SINGLE CRYSTAL; PLATE SPECIMEN; 0.1-5.0MM THICK; HIGHLY POLISHED SURFACES; NEAR NORMAL INCIDENT REFLECTION SPECTRUM OBTAINED; REFRACTIVE INDEX DEDUCED FROM REFLECTION SPECTRUM WITH LORENTZ THEORY; DATA EXTRACTED FROM A SMOOTH CURVE; LORENTZ DAMPED-OSCILLATOR DISPERSION EQUATION ALSO GIVEN.
5	47	HOUSTON,T.W. JOHNSON,L.F. KISLIUK,P. WALSH,D.J.	1963	D	0.54-1.85	93	SINGLE CRYSTAL; HIGH PURITY; PRISMATIC SPECIMEN; POLISHED SURFACES FLAT TO 1/2 WAVELENGTH OF 0.535 MICROMETER LINE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD FOR 7 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE.
6	47	HOUSTON,T.W. ET AL.	1963	D	0.54-1.85	298	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 298K.
7	67	MALITSON,I.H.	1964	D	0.40-0.77	288	SYNTHETIC CRYSTAL; GROWN AT MIT BY D. C. STOCKBARGER; PRISMATIC SPECIMEN; REFRACTIVE INDEX DETERMINED BY DEVIATION METHOD FOR 9 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; ESTIMATED UNCERTAINTY ABOUT 0.000003; THIS DATA SET WAS MEASURED AT NBS IN 1944.
8	67	MALITSON,I.H.	1964	D	0.40-0.77	308	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 308K.
9	67	MALITSON,I.H.	1964	D	0.40-0.77	328	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 328K.
10	67	MALITSON,I.H.	1964	D	0.26-10.4	298	SYNTHETIC CRYSTAL; OBTAINED FROM THE HARSHAW CHEMICAL CO.; PRISMATIC SPECIMEN; NEAR 61 DEGREE APEX ANGLE, 18MMX18MM VIEW SURFACE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD FOR 46 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; A SELLMEIRE TYPE DISPERSION EQUATION BEST FIT THE DATA ALSO GIVEN.

TABLE 27. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF BARIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
11	49	FABRE,D. ROMAND,J. VODAR,B.	1964	R	0.10-0.17	293	THIN FILM SPECIMEN OF VARYING THICKNESS; VACUUM DEPOSITED; REFRACTIVE INDEX DETERMINED BY REFLECTANCE OF VARYING THICKNESS; DATA EXTRACTED FROM A FIGURE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
12	25	NISAR,M. ROBIN,S.	1974	R	0.03-0.138	293	SINGLE CRYSTAL; OBTAINED FROM THE HARSHAW CHEMICAL CO.; SPECIMEN CLEAVED IN VACUUM; 20 DEGREE INCIDENT REFLECTION SPECTRUM OBTAINED; REFRACTIVE INDEX DEDUCED FROM REFLECTION SPECTRUM WITH KRAMERS-KRONIG RELATION; DATA EXTRACTED FROM A FIGURE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
13	53	GANIN,V.,SIDORIN,V. KARIN,M.,SIDORIN,K. STAROSTIN,N., STARTSEV,G.	1975	R	0.06-0.25	300	SINGLE CRYSTAL; FRESHLY CLEAVED SPECIMEN; NEAR NORMAL REFLECTION SPECTRUM OBTAINED; REFRACTIVE INDEX DEDUCED FROM REFLECTION SPECTRUM WITH KRAMERS-KRONIG RELATION; DATA EXTRACTED FROM A FIGURE.

TABLE 28. EXPERIMENTAL REFRACTIVE INDEX OF BARIUM FLUORIDE (WAVELENGTH DEPENDENCE)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n)

λ	n
DATA SET 1	
T = 293.0	
0.589	1.475
DATA SET 2	
T = 298.0	
0.589	1.47410
DATA SET 3	
T = 298.0	
0.589	1.47410
DATA SET 4	
T = 300.0	
10.0	1.42
13.9	1.36
17.6	1.29
20.8	1.19
22.7	1.09
24.2	1.03
26.2	0.89
28.3	0.65
30.0	0.41
31.3	0.16
33.8	0.16
37.6	0.16
40.0	0.11
43.8	0.09
46.0	0.09
48.0	0.24
50.0	0.45
51.4	0.84
52.2	1.21
52.8	1.76
53.1	2.30
53.3	3.07
53.4	3.78
53.5	4.51
DATA SET 4(CONT.)	
53.6	5.33
53.8	6.01
53.9	6.80
54.0	8.25
54.2	9.78
54.4	10.52
54.5	11.29
54.7	12.23
55.0	11.63
55.2	10.91
55.5	10.20
55.7	9.52
55.9	8.78
56.3	8.03
56.6	7.31
57.3	6.68
58.2	5.94
59.1	5.53
60.0	5.09
61.7	4.73
63.1	4.41
65.3	4.09
67.2	3.93
69.9	3.69
73.8	3.55
77.3	3.41
80.9	3.32
DATA SET 5	
T = 93.0	
0.5461	1.4787
0.5890	1.4775
0.7665	1.4738
0.8195	1.4735
1.0140	1.4722
1.5166	1.4711
1.8459	1.4711
DATA SET 6	
T = 295.0	
0.5461	1.4760
0.5890	1.4745
0.7665	1.4709
0.8195	1.4701
1.0140	1.4696
1.5166	1.4684
1.8459	1.4684
DATA SET 7	
T = 298.0	
0.404656	1.484054
0.435834	1.481416
0.486132	1.478234
0.546074	1.475559
0.589262	1.474124
0.656279	1.472439
0.667814	1.472196
0.706518	1.471474
0.767858	1.470538
DATA SET 8	
T = 308.0	
0.404656	1.483753
0.435834	1.481116
0.486132	1.477930
0.546074	1.475255
0.589262	1.473820
0.656279	1.472135
0.667814	1.471892
0.706518	1.471167
0.767858	1.470230
DATA SET 9	
T = 328.0	
0.404656	1.483452
0.435834	1.480816
DATA SET 9(CONT.)	
0.486132	1.477628
0.546074	1.474951
0.589262	1.473515
0.656279	1.471830
0.667814	1.471586
0.706518	1.470863
0.767858	1.469920
DATA SET 10	
T = 298.0	
0.2652	1.51217
0.28035	1.50668
0.28936	1.50390
0.296728	1.50186
0.30215	1.50044
0.3130	1.49782
0.32546	1.49521
0.334148	1.49363
0.340365	1.49257
0.34662	1.49158
0.361051	1.48939
0.366328	1.48869
0.404656	1.48438
0.435835	1.48173
0.486133	1.47855
0.546074	1.47586
0.589262	1.47443
0.643847	1.47302
0.656279	1.47274
0.706519	1.47177
0.85211	1.46984
0.89435	1.46942
1.01398	1.46847
1.12846	1.46779
1.36728	1.46673
1.52952	1.46613
1.681	1.46561
1.7012	1.46554
1.97009	1.46472
DATA SET 10(CONT.)	
2.1526	1.46410
2.32542	1.46356
2.5766	1.46262
2.6738	1.46234
3.2434	1.46018
3.422	1.45940
5.138	1.45012
5.3034	1.44904
5.343	1.44878
5.549	1.44732
6.238	1.44216
6.6331	1.43899
6.8559	1.43694
7.0442	1.43529
7.268	1.43314
9.724	1.40514
10.346	1.39636
DATA SET 11	
T = 293.0	
0.1015	1.99
0.1042	1.95
0.1068	1.88
0.1095	1.81
0.1123	1.72
0.1136	1.69
0.1144	1.69
0.1162	1.72
0.1189	1.80
0.1211	1.91
0.1240	2.10
0.1258	2.25
0.1263	2.27
0.1270	2.29
0.1281	2.24
0.1302	2.12
0.1321	2.05
0.1353	1.95
0.1378	1.90
DATA SET 11(CONT.)	
0.1430	1.84
0.1489	1.79
0.1562	1.76
0.1625	1.72
0.1684	1.71
DATA SET 12	
T = 293.0	
0.0376	1.15
0.0379	1.16
0.0380	1.16
0.0382	1.15
0.0385	1.13
0.0389	1.14
0.0392	1.15
0.0386	1.13
0.0396	1.15
0.0401	1.13
0.0406	1.10
0.0407	1.10
0.0413	1.09
0.0416	1.09
0.0420	1.09
0.0424	1.08
0.0430	1.05
0.0433	1.02
0.0438	1.03
0.0441	1.07
0.0446	1.11
0.0447	1.12
0.0454	1.10
0.0459	1.06
0.0460	1.06
0.0464	1.07
0.0471	1.07
0.0476	1.06
0.0484	1.16
0.0494	1.25
0.0496	1.28

TABLE 28. EXPERIMENTAL REFRACTIVE INDEX OF BARIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n)

λ	n	λ	n	λ	n	λ	n
DATA SET 12(CONT.)		DATA SET 12(CONT.)		DATA SET 12(CONT.)		DATA SET 13(CONT.)	
0.0500	1.36	0.0677	1.47	0.1068	2.09	0.0987	1.79
0.0502	1.45	0.0681	1.65	0.1087	1.99	0.1038	1.98
0.0504	1.49	0.0685	1.62	0.1097	1.95	0.1066	1.87
0.0510	1.49	0.0692	1.45	0.1117	1.91	0.1122	1.72
0.0514	1.51	0.0700	1.34	0.1127	1.89	0.1185	1.75
0.0518	1.54	0.0704	1.33	0.1148	1.88	0.1218	2.81
0.0521	1.52	0.0712	1.37	0.1169	1.90	0.1235	2.89
0.0525	1.58	0.0716	1.44	0.1192	1.95	0.1246	2.70
0.0529	1.64	0.0720	1.50	0.1215	2.10	0.1287	2.21
0.0534	1.68	0.0733	1.71	0.1227	2.32	0.1305	1.99
0.0539	1.70	0.0738	2.05	0.1240	2.50	0.1376	1.79
0.0541	1.70	0.0742	2.30	0.1252	2.48	0.1460	1.68
0.0548	1.67	0.0746	2.33	0.1278	2.43	0.1677	1.59
0.0551	1.64	0.0751	2.18	0.1291	2.31	0.1913	1.52
0.0556	1.67	0.0756	1.88	0.1319	2.19	0.2190	1.52
0.0561	1.67	0.0760	1.81	0.1377	2.00	0.2561	1.47
0.0568	1.90	0.0775	1.64			0.3679	1.43
0.0576	2.16	0.0789	1.50	DATA SET 13		0.5486	1.46
0.0579	2.19	0.0800	1.48	T = 300.0			
0.0582	2.15	0.0815	1.50				
0.0590	2.02	0.0849	1.56	0.0592	0.79		
0.0599	1.91	0.0855	1.60	0.0610	0.64		
0.0604	1.73	0.0861	1.62	0.0625	0.76		
0.0610	1.68	0.0873	1.74	0.0641	0.78		
0.0616	1.64	0.0885	1.85	0.0656	0.87		
0.0620	1.60	0.0892	1.87	0.0676	0.85		
0.0626	1.53	0.0899	1.85	0.0691	0.87		
0.0629	1.47	0.0911	1.73	0.0708	0.76		
0.0632	1.51	0.0925	1.65	0.0717	0.83		
0.0636	1.64	0.0932	1.65	0.0726	1.11		
0.0642	1.98	0.0939	1.67	0.0747	1.11		
0.0645	2.10	0.0953	1.66	0.0775	1.07		
0.0649	2.07	0.0961	1.77	0.0795	1.02		
0.0652	1.98	0.0976	2.10	0.0822	1.02		
0.0656	1.94	0.0992	2.41	0.0848	1.07		
0.0659	1.80	0.1000	2.47	0.0864	1.26		
0.0663	1.81	0.1008	2.45	0.0903	1.41		
0.0666	1.85	0.1016	2.43	0.0935	1.24		
0.0670	1.63	0.1042	2.29	0.0956	1.09		
0.0672	1.43	0.1059	2.20	0.0976	1.32		

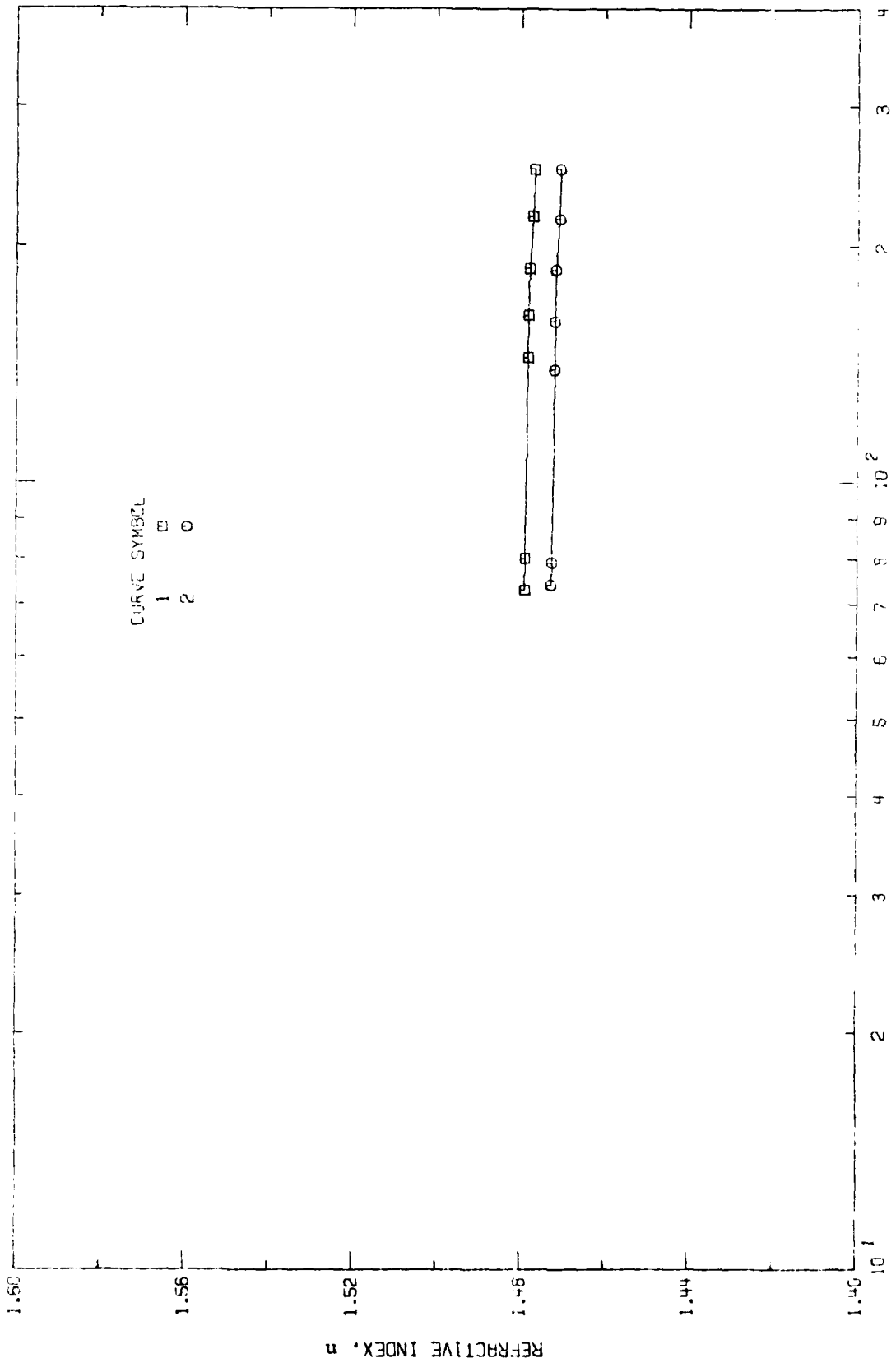


FIGURE 18. REFRACTIVE INDEX OF BARIUM FLUORIDE AT TEMPERATURES BETWEEN 1.

TABLE 29. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF BARIUM FLUORIDE (TEMPERATURE DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	47	HOUSTON,T.W. JOHNSON,L.F. KISLIUK,P. WALSH,D.J.	1963	D	0.5461	73-250	SINGLE CRYSTAL; HIGH PURITY; PRISMATIC SPECIMEN; POLISHED SURFACES FLAT TO 1/2 WAVELENGTH OF 0.535 MICROMETER LINE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD FOR THE SPECTRAL LINE 0.5461 MICROMETERS; DATA EXTRACTED FROM A TABLE.
2	47	HOUSTON,T.W. ET AL.	1963	D	1.0140	74-250	SIMILAR TO ABOVE CUT FOR A LONGER WAVELENGTH.

TABLE 30. EXPERIMENTAL REFRACTIVE INDEX OF BARIUM FLUORIDE (TEMPERATURE DEPENDENCE)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n)

T	n
DATA SET 1	
λ = 0.546	
73.0	1.47909
90.0	1.47899
144.0	1.47842
163.0	1.47820
187.0	1.47798
216.0	1.47731
250.0	1.47675
DATA SET 2	
λ = 1.014	
74.0	1.47278
79.0	1.47253
139.0	1.47208
168.0	1.47186
186.0	1.47175
216.0	1.47086
258.0	1.47063

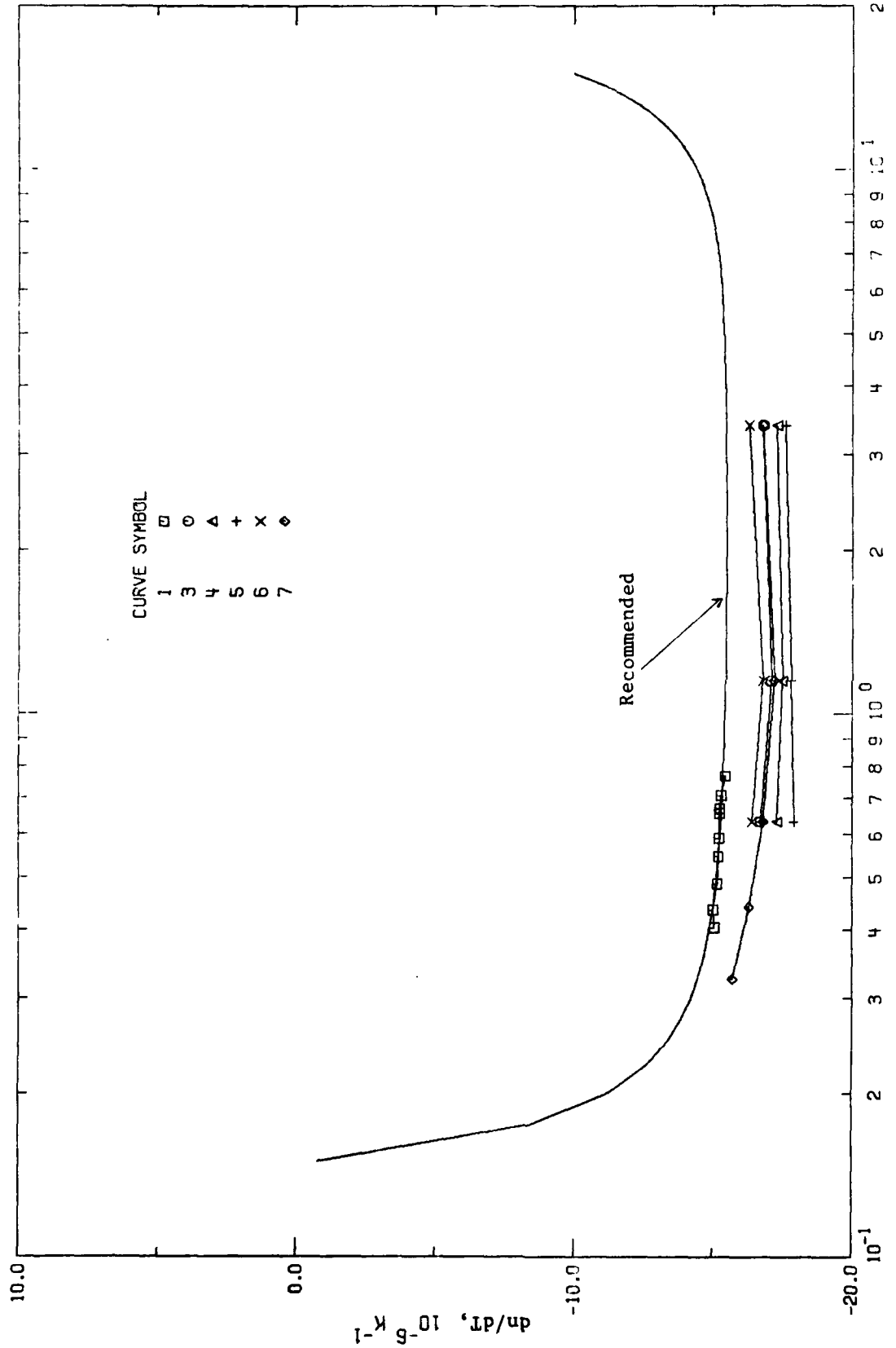


FIGURE 19. TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF BARIUM FLUORIDE (WAVELENGTH REFERENCED

TABLE 31. MEASUREMENT INFORMATION ON THE TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF BARIUM FLUORIDE (WAVELENGTH DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	67	MALITSON,I.H.	1964	D	0.40-0.77	308	SYNTHETIC CRYSTAL; GROWN AT MIT BY D. C. STOCKBARGER; PRISMATIC SPECIMEN; REFRACTIVE INDEX DETERMINED BY DEVIATION METHOD; DN/DT DETERMINED FOR 9 SPECTRAL LINES USING THE INDICES MEASURED AT 288, 308 AND 328K; DATA EXTRACTED FROM A TABLE.
2	67	MALITSON,I.H.	1964	D	0.26-10.4	296	SYNTHETIC CRYSTAL; OBTAINED FROM THE HARSHAW CHEMICAL CO.; PRISMATIC SPECIMEN; NEAR 61 DEGREE APEX ANGLE, 18MMX18MM VIEW SURFACE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD FOR 46 SPECTRAL LINES; DN/DT DETERMINED USING INDICES MEASURED AT ABOUT 288 AND 303K, NO DEFINITE RESULTS REPORTED BUT AVERAGED VALUES $-11X10^{-6}K^{-1}$ IN NEAR ULTRAVIOLET, -15 IN VISIBLE, -17 IN IN NEAR INFRARED AND -9 AT LONG WAVELENGTH LIMIT; DATA EXTRACTED FROM A TABLE.
3	59	LIPSON,H.G. TSAY,Y.F. BENDOW,B LIGOR,P.A.	1976	I	0.63-3.39	310	SINGLE CRYSTAL; DISC SPECIMEN; 1.90CM DIAMETER, 1CM TO 2.5CM THICK; DN/DT DETERMINED FOR 3 SPECTRAL LINES BY OBSERVING THE INTERFERENCE FRINGE CHANGES AND THE CORRESPONDING TEMPERATURE CHANGES; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF DN/DT ABOUT $0.4X10^{-6}K^{-1}$.
4	59	LIPSON,H.G. ET AL.	1976	I	0.63-3.39	330	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 330K; UNCERTAINTY OF DN/DT $0.4X10^{-6}K^{-1}$.
5	59	LIPSON,H.G. ET AL.	1976	I	0.63-3.39	350	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE OF 350K; UNCERTAINTY OF DN/DT $0.4X10^{-6}K^{-1}$.
6	68	HARRIS,R.J. JOHNSTON,G.T. KEPPLE,G.A. KROK,P.C.,MUKAI,H.	1977	I	0.63-3.39	318	POLYCRYSTALLINE; OBTAINED FROM THE HARSHAW CHEMICAL CO.; PLATE SPECIMEN; DN/DT DETERMINED DIRECTLY FOR 3 SPECTRAL LINES BY OBSERVING THE FIZEAU INTERFERENCE FRINGE CHANGES AND THE CORRESPONDING TEMPERATURE CHANGES; MEASUREMENTS MADE FROM 298 TO 338K, THE AVERAGED VALUES OF DN/DT WERE GIVEN; DATA EXTRACTED FROM A TABLE.
7	92	TSAY,Y.F. LIPSON,H.G. LIGOR,P.A.	1977	I	0.32-3.39	310	SINGLE CRYSTAL; DISC SPECIMEN; 1.90CM DIAMETER, 1.27CM THICK; DN/DT DETERMINED BY OBSERVING THE INTERFERENCE FRINGE CHANGES AND THE CORRESPONDING TEMPERATURE CHANGES DATA EXTRACTED FROM A FIGURE; UNCERTAINTY OF DN/DT ABOUT $1.0X10^{-6}K^{-1}$.

TABLE 32. EXPERIMENTAL TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF BARIUM FLUORIDE (WAVELENGTH DEPENDENCE)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX , dn/dT, 10^{-6} K^{-1})

λ	dn/dT
DATA SET 1	
T = 308.0	
0.404656	-15.05
0.435834	-15.00
0.486132	-15.15
0.546074	-15.20
0.589262	-15.22
0.656279	-15.23
0.667814	-15.25
0.706518	-15.28
0.767858	-15.45
DATA SET 2	
T = 296.0	
0.26-0.4	-11.0
0.4-0.7	-15.0
0.7-9.7	-17.0
10.35	-9.0
DATA SET 3	
T = 318.0	
0.6328	-16.7
1.15	-17.1
3.39	-16.8
DATA SET 4	
T = 330.0	
0.6328	-17.3
1.15	-17.5
3.39	-17.3
DATA SET 5	
T = 350.0	
0.6328	-17.9
1.15	-17.8
3.39	-17.6
DATA SET 6	
T = 318.0	
0.6328	-16.4
1.15	-16.8
3.39	-16.3
DATA SET 7	
T = 310.0	
0.325	-15.7
0.4416	-16.3
0.6328	-16.8
1.15	-17.2
3.39	-16.8

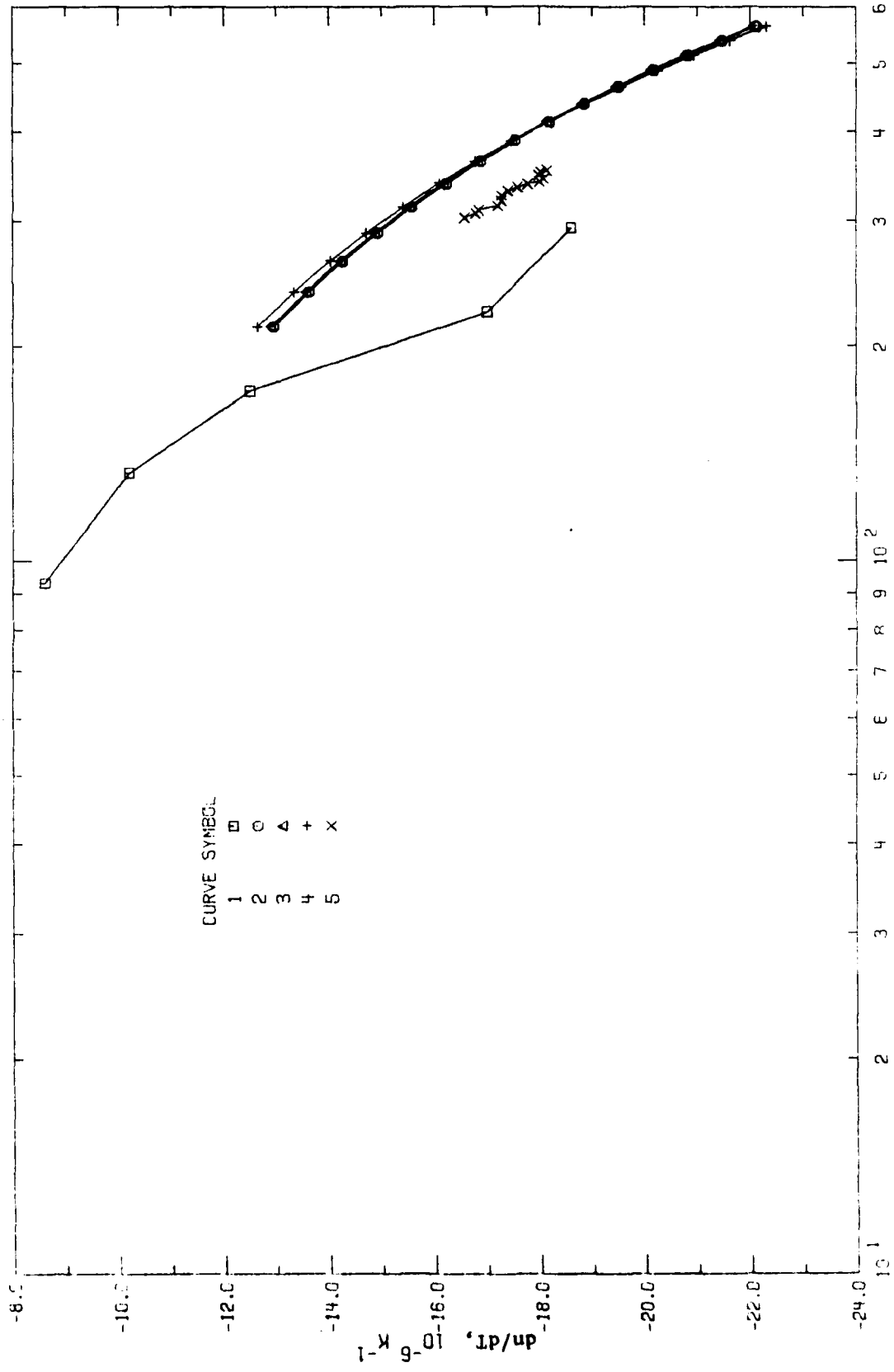


FIGURE 20. TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF BARIUM FLUORIDE (TEMPERATURE DEPENDENCE).

TABLE 33. MEASUREMENT INFORMATION ON THE TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF BARIUM FLUORIDE (TEMPERATURE DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	47	HOUSTON,T.W. JOHNSON,L.F. KISLIUK,P. WALSH,D.J.	1963	D	0.5461	93-293	SINGLE CRYSTAL; HIGH PURITY; PRISMATIC SPECIMEN; POLISHED SURFACES FLAT TO 1/2 WAVELENGTH OF 0.535 MICROMETER LINE; REFRACTIVE INDEX DETERMINED BY MINIMUM DEVIATION METHOD; DN/DT DETERMINED USING INDICES MEASURED AT 93 TO 293K, FOR 0.5461 MICROMETER LINE; DN/DT VALUES FOR 1.014 MICROMETER ARE THE SAME AS THIS SET; DATA EXTRACTED FROM A TABLE.
2	68	SELEZNEVA,A.M.	1969	I	0.656	213-573	SYNTHETIC CRYSTAL; PRODUCED IN THE SOVIET UNION; WELL ANNEALED; TEMPERATURE COEFFICIENT OF REFRACTIVE INDEX DETERMINED BY INTERFERENCE METHOD; EMPIRICAL FORMULA PROPOSED FOR CALCULATION OF DN/DT; DATA EXTRACTED BY EVALUATING A GIVEN EQUATION.
3	68	SELEZNEVA,A.M.	1969	I	0.589	213-573	SIMILAR TO ABOVE BUT FOR WAVELENGTH 0.589 MICROMETERS.
4	68	SELEZNEVA,A.M.	1969	I	0.486	213-573	SIMILAR TO ABOVE BUT FOR WAVELENGTH 0.486 MICROMETERS.
5	59	LIPSON,H.G. ISAY,Y.F. BENDOW,B LIGOR,P.A.	1976	I	0.6328	300-353	SINGLE CRYSTAL; DISC SPECIMEN; 1.90CM DIAMETER, 1CM TO 2.5CM THICK; DN/DT DETERMINED BY OBSERVING THE INTERFERENCE FRINGE CHANGES AND THE CORRESPONDING TEMPERATURE CHANGES; DATA EXTRACTED FROM A FIGURE; UNCERTAINTY OF DN/DT ABOUT $0.5X10^{-6}K^{-1}$.

TABLE 34. EXPERIMENTAL TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF BARIUM FLUORIDE (TEMPERATURE DEPENDENCE)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX , dn/dT, 10^{-6} K^{-1})

T	dn/dT
DATA SET 1	
λ = 0.546	
93.0	-8.6
133.0	-10.2
173.0	-12.5
223.0	-17.0
293.0	-18.6
DATA SET 2	
λ = 0.656	
213.0	-12.95
238.0	-13.61
263.0	-14.26
288.0	-14.92
313.0	-15.57
338.0	-16.23
363.0	-16.98
388.0	-17.54
413.0	-18.19
438.0	-18.85
463.0	-19.50
488.0	-20.16
513.0	-20.81
538.0	-21.47
563.0	-22.12
DATA SET 3	
λ = 0.589	
213.0	-12.90
238.0	-13.56
263.0	-14.21
288.0	-14.87
313.0	-15.52
338.0	-16.18
363.0	-16.83
388.0	-17.49
413.0	-18.14
438.0	-18.80
463.0	-19.45
DATA SET 3(CONT.)	
489.0	-20.11
513.0	-20.76
538.0	-21.42
563.0	-22.07
DATA SET 4	
λ = 0.486	
213.0	-12.64
238.0	-13.33
263.0	-14.02
288.0	-14.71
313.0	-15.40
338.0	-16.09
363.0	-16.78
388.0	-17.47
413.0	-18.16
438.0	-18.85
463.0	-19.54
488.0	-20.23
513.0	-20.92
538.0	-21.61
563.0	-22.30
DATA SET 5	
λ = 0.632	
302.564	-16.580
306.462	-16.780
309.949	-16.940
314.667	-17.200
320.000	-17.280
325.538	-17.280
329.846	-17.408
333.538	-17.580
337.231	-17.780
339.692	-18.000
343.590	-18.080
347.282	-17.980
350.359	-18.020
DATA SET 5(CONT.)	
352.821	-18.140

TABLE 35. COMPARISON OF DISPERSION EQUATIONS PROPOSED FOR BaF_2

Source	Wavelength and Temperature Ranges	Dispersion Equation λ in μm; ν in cm^{-1}
Kaiser, W., Spitzer, W.G., aiser, R.H., and owarth, L.E. 1962	10–80 μm	$n^2 - k^2 = \epsilon_\infty + \Sigma\, 4\pi\rho_i \nu_i^2 \dfrac{\nu_i^2 - \nu^2}{(\nu_i^2 - \nu^2)^2 + \gamma_i^2 \nu^2 \nu_i^2}$ $2nk = \sum_i 4\pi\rho_i \nu_i^2 \dfrac{\gamma_i \nu \nu_i}{(\nu_i^2 - \nu^2)^2 + \gamma_i^2 \nu^2 \nu_i^2}$ *
Malitson, I.H. 1964	0.2652–10.346 μm 298 K	$n^2 = 1 + \dfrac{0.643356\,\lambda^2}{\lambda^2 - (0.057789)^2} + \dfrac{0.506762\,\lambda^2}{\lambda^2 - (0.10968)^2} + \dfrac{3.8261\,\lambda^2}{\lambda^2 - (46.3864)^2}$
Selezneva, 1969	213–573 K	$\dfrac{dn}{dt} = a + 2b\,(T - 293.0)$ †
Present work 1977	0.15–15.0 μm 293 K	$n^2 = 1.33973 + \dfrac{0.81070\,\lambda^2}{\lambda^2 - (0.10065)^2} + \dfrac{0.19652\,\lambda^2}{\lambda^2 - (29.87)^2} + \dfrac{4.52469\,\lambda^2}{\lambda^2 - (53.82)^2}$

* $i = 1, 2$; $4\pi\rho_1 = 4.50$, $4\pi\rho_2 = 0.07$; $\nu_1 = 184\ cm^{-1}$, $\nu_2 = 278\ cm^{-1}$; $\gamma_1 = 0.020$, $\gamma_2 = 0.30$.
† For $\lambda = 0.656\ \mu$m, $a = -15.05 \times 10^{-6}$, $b = -1.31 \times 10^{-8}$; for $\lambda = 0.589\ \mu$m, $a = -15.00 \times 10^{-6}$, $b = -1.31 \times 10^{-8}$; for $\lambda = 0.486\ \mu$m, $a = -14.85 \times 10^{-6}$, $b = -1.38 \times 10^{-8}$.

3.4 Magnesium Fluoride, MgF_2

Magnesium fluoride is an anisotropic ionic crystal having a rutile structure. It has a large forbidden gap and hence it is transparent in the UV and is used as an optical material in this spectral region. It is of particular interest in vacuum UV spectroscopy because of its use as a reflective coating for mirrors and gratings. It has been found that a MgF_2 layer of suitable thickness, evaporated onto aluminum, retards oxidation of the aluminum and greatly increases the reflectance in the vacuum UV. The application of MgF_2 to an aluminum-surfaced replica grating results in a much improved efficiency down to 0.11 micrometer.

The crystal can be grown in vacuum using the Stockbarger technique. Large specimens with weight over 2 kg and diameter of about 10 cm are available. MgF_2 is a uniaxial positive crystal and is transparent from 0.11 to 7.5 micrometers. When used as a reflector, it is highly polarizing for wavelengths less than 0.124 micrometer.

Although this material is transparent in the infrared up to 7.5 micrometers, measurements of refractive index were carried out only for the ultraviolet and visible regions. This fact can be realized from tables 37 and 38, in which we have compiled 38 data sets, including a few sets of thin film data for comparison. It is clear from the table that the majority of the measurements are either for vacuum ultraviolet beyond the transparent region

or for thin films. For the transparent region, Steinmeltz et al. [77] reported refractive indices of ordinary and extraordinary rays for four spectral lines from 0.178 to 0.2894 micrometer. Duncanson et al. [18] measured the refractive indices for the two rays at 18 wavelengths in the visible spectrum (0.4-0.7 micrometer). In our compilation, 0.7 micrometer is the longest wavelength at which both n_o and n_e have been measured. No measurement of n_o and n_e beyond the visible in the infrared region has been reported. However, refractive indices for the infrared region from 1.0 to 9.0 micrometers are available for IRTRAN 1, a hot pressed polycrystalline magnesium fluoride.

As mentioned above, the available data on the refractive indices of single crystals are very scanty. The crystal is transparent for a quite wide spectral region, about 7.5 micrometers in width, yet measurements have been carried out only over a range 0.5 micrometer in width, less than 7 percent of the total transparent region. Although Duncanson's values are accurate and reliable, the spectral range covered is narrow. Furthermore, the dispersion in the refractive indices is small, from 1.38359 to 1.37599 for the ordinary ray and from 1.39566 to 1.38771 for the extraordinary ray, not suitable for a wide range prediction. As a result, the Hartmann interpolation formulae (proposed by Duncanson et al. [18])

$n=1.36957 + 0.003582/(\lambda-0.14925)$ for the ordinary ray

and $n=1.38100 + 0.0037415/(\lambda-0.14947)$ for the extraordinary ray,

are good only for the narrow spectral region from 0.4 to 0.7 micrometer.

In the present work, the available data are only a part of the input information needed for a Sellmeier dispersion equation. In order to get meaningful predictions for the whole transparent region, the key parameters for the dispersion equation are, for each ray, the dielectric constant, the effective UV resonant wavelength, the infrared resonant wavelength and if possible the strengths of each of the resonant wavelengths. It is fortunate indeed that these key parameters, although not having been used for such purposes, are available in the literature (Barker [14] see tables 4, 5 and 6). Introduction of the key parameters into the Sellmeier equation yields fits to available data that are as close as the fits to the Hartmann formulae. The resulting equations for single crystal MgF_2 at 293K in the transparent region, 0.14-7.5 micrometers, are:

$$n^2 = 1.27620 + \frac{0.60967\ \lambda^2}{\lambda^2 - 0.08636^2} + \frac{0.0080\ \lambda^2}{\lambda^2 - 18.0^2} + \frac{2.14973\ \lambda^2}{\lambda^2 - 25.0^2} \quad \text{(o-ray)}, \tag{24}$$

$$n^2 = 1.25385 + \frac{0.66405\ \lambda^2}{\lambda^2 - 0.08504^2} + \frac{1.0899\ \lambda^2}{\lambda^2 - 22.2^2} + \frac{0.1816\ \lambda^2}{\lambda^2 - 24.4^2} + \frac{2.1227\ \lambda^2}{\lambda^2 - 40.6^2} \quad \text{(e-ray)}, \tag{25}$$

where λ is in units of micrometers. It should be noted that Barker's values have been modified so that the difference of refractive index between ordinary and extraordinary ray agree with the observed birefringence except in the region where anomalies of birefringence occur. Barker's values were so modified that the ratios of the parameters remained unchanged.

For the available data of IRTRAN 1 we simply fit the data to a Sellmeier type equation, to obtain

$$n^2 = 1.79079 + \frac{0.10822\,\lambda^2}{\lambda^2 - 0.16733^2} + \frac{2.7814\,\lambda^2}{\lambda^2 - 25.54^2} \text{ (IRTRAN 1)}. \qquad (26)$$

This equation is found to be as good as the Herzberger dispersion equation given in Ref. [20].

Equations (24) to (26) were used to generate the reference data given in the table of recommended values. Values of $dn/d\lambda$ were simply evaluated by taking the first derivative of these equations. Although the values of n are given to the fifth decimal place, this does not reflect the degree of accuracy and the extent of reliability. The values are so given simply for smoothness of tabulation. For the proper use of the tabulated values the reader should follow the criteria given below.

For ordinary and extraordinary rays:

Wavelength range micrometer	Estimated uncertainty,*
0.15-0.20	0.01
0.20-0.30	0.005
0.30-0.70	0.0001
0.70-1.0	0.003
1.0-5.0	0.005
5.0-10.0	0.01

For IRTRAN 1:

0.18-0.3	>0.05

0.3-1.0	>0.01
1.0-10.0	0.001

TABLE 36. RECOMMENDED VALUES ON THE REFRACTIVE INDEX AND ITS WAVELENGTH DERIVATIVE FOR MAGNESIUM FLUORIDE AT 293K*

λ	Ordinary Ray		Extraordinary Ray		IRTRAN 1		λ	Ordinary Ray		Extraordinary Ray		IRTRAN 1	
μm	n_o	$-dn_o/d\lambda$	n_e	$-dn_e/d\lambda$	n	$-dn/d\lambda$	μm	n_o	$-dn_o/d\lambda$	n_e	$-dn_e/d\lambda$	n	$-dn/d\lambda$
0.150	1.47920	2.03784	1.49410	2.06854	-----	-----	0.270	1.39825	0.20566	1.41094	0.21383	1.40221	0.29022
0.152	1.47525	1.91379	1.49009	1.94487	-----	-----	0.272	1.39784	0.20057	1.41052	0.20856	1.40164	0.27910
0.154	1.47154	1.80031	1.48632	1.83153	-----	-----	0.274	1.39744	0.19565	1.41010	0.20347	1.40109	0.26821
0.156	1.46804	1.69623	1.48276	1.72742	-----	-----	0.276	1.39706	0.19089	1.40970	0.19855	1.40056	0.25811
0.158	1.46475	1.60055	1.47940	1.63156	-----	-----	0.278	1.39668	0.18629	1.40931	0.19379	1.40006	0.24855
0.160	1.46164	1.51240	1.47623	1.54311	-----	-----	0.280	1.39631	0.18185	1.40893	0.18918	1.39957	0.23949
0.162	1.45870	1.43103	1.47322	1.46135	-----	-----	0.282	1.39597	0.17754	1.40855	0.18473	1.39910	0.23091
0.164	1.45591	1.35575	1.47039	1.38562	-----	-----	0.284	1.39560	0.17338	1.40819	0.18042	1.39865	0.22277
0.166	1.45327	1.28600	1.46768	1.31535	-----	-----	0.286	1.39526	0.16935	1.40783	0.17624	1.39821	0.21503
0.168	1.45076	1.22124	1.46511	1.25003	-----	-----	0.288	1.39493	0.16545	1.40748	0.17220	1.39779	0.20768
0.170	1.44838	1.16102	1.46267	1.18923	-----	-----	0.290	1.39460	0.16167	1.40714	0.16828	1.39738	0.20069
0.172	1.44612	1.10493	1.46035	1.13253	-----	-----	0.292	1.39429	0.15801	1.40681	0.16449	1.39698	0.19405
0.174	1.44396	1.05261	1.45814	1.07958	-----	-----	0.294	1.39397	0.15446	1.40648	0.16081	1.39660	0.18774
0.176	1.44190	1.00372	1.45603	1.03007	-----	-----	0.296	1.39366	0.15102	1.40617	0.15725	1.39623	0.18176
0.178	1.43994	0.95799	1.45402	0.98371	-----	-----	0.298	1.39336	0.14769	1.40586	0.15379	1.39587	0.17608
0.180	1.43807	0.91515	1.45210	0.94024	1.60455	17.50927	0.300	1.39307	0.14445	1.40555	0.15043	1.39553	0.17069
0.182	1.43628	0.87497	1.45026	0.89943	1.57802	13.33756	0.305	1.39237	0.13678	1.40482	0.14244	1.39471	0.15764
0.184	1.43457	0.83723	1.44850	0.86107	1.55443	10.45737	0.310	1.39170	0.12966	1.40413	0.13503	1.39395	0.14626
0.186	1.43293	0.80174	1.44681	0.82497	1.53364	8.43441	0.315	1.39107	0.12304	1.40347	0.12822	1.39324	0.13601
0.188	1.43136	0.76834	1.44519	0.79097	1.51533	6.94644	0.320	1.39047	0.11687	1.40284	0.12182	1.39259	0.12677
0.190	1.42985	0.73686	1.44365	0.75891	1.50762	5.81990	0.325	1.38990	0.11113	1.40225	0.11585	1.39197	0.11840
0.192	1.42841	0.70717	1.44216	0.72863	1.49649	4.94641	0.330	1.38936	0.10576	1.40169	0.11029	1.39140	0.11091
0.194	1.42702	0.67913	1.44073	0.70003	1.48771	4.25541	0.335	1.38884	0.10075	1.40115	0.10507	1.39087	0.10391
0.196	1.42569	0.65262	1.43936	0.67298	1.47978	3.69934	0.340	1.38835	0.09605	1.40063	0.10013	1.39036	0.09760
0.198	1.42441	0.62755	1.43804	0.64735	1.47285	3.24520	0.345	1.38788	0.09166	1.40014	0.09562	1.38989	0.09163
0.200	1.42318	0.60380	1.43677	0.62310	1.46674	2.86951	0.350	1.38743	0.08753	1.39968	0.09133	1.38944	0.08594
0.202	1.42200	0.58129	1.43554	0.60009	1.46133	2.55519	0.355	1.38700	0.08366	1.39923	0.08730	1.38902	0.08149
0.204	1.42086	0.55994	1.43437	0.57824	1.45649	2.28955	0.360	1.38660	0.08002	1.39880	0.08352	1.38863	0.07726
0.206	1.41976	0.53967	1.43323	0.55749	1.45214	2.06303	0.365	1.38620	0.07660	1.39839	0.07995	1.38825	0.07327
0.208	1.41870	0.52042	1.43213	0.53776	1.44822	1.86833	0.370	1.38583	0.07337	1.39800	0.07660	1.38789	0.06950
0.210	1.41767	0.50210	1.43108	0.51900	1.44465	1.69974	0.375	1.38547	0.07033	1.39763	0.07343	1.38756	0.06591
0.212	1.41669	0.48468	1.43006	0.50114	1.44140	1.55290	0.380	1.38513	0.06746	1.39727	0.07045	1.38724	0.06249
0.214	1.41573	0.46809	1.42907	0.48412	1.43843	1.42336	0.385	1.38480	0.06475	1.39692	0.06763	1.38693	0.05918
0.216	1.41481	0.45227	1.42812	0.46789	1.43570	1.31036	0.390	1.38448	0.06219	1.39659	0.06496	1.38664	0.05604
0.218	1.41392	0.43719	1.42720	0.45241	1.43318	1.20970	0.395	1.38417	0.05977	1.39627	0.06244	1.38637	0.05309
0.220	1.41306	0.42281	1.42631	0.43764	1.43085	1.12004	0.400	1.38388	0.05748	1.39597	0.06005	1.38610	0.05142
0.222	1.41223	0.40907	1.42545	0.42352	1.42869	1.03995	0.410	1.38333	0.05324	1.39539	0.05564	1.38561	0.04694
0.224	1.41143	0.39595	1.42462	0.41004	1.42668	0.96832	0.420	1.38281	0.04944	1.39485	0.05167	1.38516	0.04331
0.226	1.41065	0.38340	1.42381	0.39714	1.42481	0.90320	0.430	1.38234	0.04600	1.39435	0.04809	1.38475	0.03995
0.228	1.40989	0.37140	1.42303	0.38479	1.42307	0.84459	0.440	1.38189	0.04288	1.39389	0.04485	1.38437	0.03687
0.230	1.40916	0.35992	1.42227	0.37298	1.42143	0.79143	0.450	1.38148	0.04006	1.39346	0.04190	1.38402	0.03374
0.232	1.40845	0.34892	1.42154	0.36166	1.41990	0.74306	0.460	1.38109	0.03749	1.39305	0.03922	1.38369	0.03130
0.234	1.40777	0.33838	1.42082	0.35081	1.41846	0.69832	0.470	1.38073	0.03515	1.39267	0.03674	1.38339	0.02912
0.236	1.40710	0.32829	1.42013	0.34041	1.41710	0.65654	0.480	1.38039	0.03301	1.39231	0.03455	1.38311	0.02715
0.238	1.40645	0.31859	1.41946	0.33042	1.41582	0.62149	0.490	1.38007	0.03106	1.39198	0.03251	1.38285	0.02539
0.240	1.40581	0.30930	1.41881	0.32084	1.41461	0.58744	0.500	1.37977	0.02926	1.39166	0.03064	1.38260	0.02379
0.242	1.40522	0.30037	1.41818	0.31164	1.41347	0.55605	0.510	1.37948	0.02762	1.39137	0.02892	1.38237	0.02233
0.244	1.40462	0.29180	1.41756	0.30280	1.41239	0.52707	0.520	1.37921	0.02610	1.39108	0.02734	1.38216	0.02101
0.246	1.40405	0.28356	1.41697	0.29431	1.41136	0.50025	0.530	1.37896	0.02470	1.39082	0.02589	1.38195	0.01981
0.248	1.40349	0.27564	1.41639	0.28614	1.41038	0.47539	0.540	1.37872	0.02341	1.39057	0.02454	1.38176	0.01871
0.250	1.40295	0.26803	1.41582	0.27828	1.40946	0.45229	0.550	1.37849	0.02222	1.39033	0.02330	1.38158	0.01771
0.252	1.40242	0.26070	1.41527	0.27071	1.40857	0.43080	0.560	1.37827	0.02112	1.39010	0.02215	1.38141	0.01679
0.254	1.40190	0.25366	1.41474	0.26343	1.40773	0.41077	0.570	1.37807	0.02010	1.38988	0.02109	1.38124	0.01595
0.256	1.40140	0.24689	1.41422	0.25641	1.40693	0.39204	0.580	1.37787	0.01915	1.38968	0.02009	1.38109	0.01517
0.258	1.40092	0.24031	1.41371	0.24965	1.40616	0.37460	0.590	1.37769	0.01826	1.38948	0.01917	1.38094	0.01446
0.260	1.40044	0.23408	1.41322	0.24313	1.40543	0.35824	0.600	1.37751	0.01744	1.38929	0.01831	1.38080	0.01380
0.262	1.39998	0.22792	1.41274	0.23685	1.40473	0.34290	0.620	1.37717	0.01597	1.38894	0.01677	1.38053	0.01263
0.264	1.39953	0.22206	1.41227	0.23079	1.40406	0.32850	0.640	1.37687	0.01464	1.38862	0.01543	1.38029	0.01163
0.266	1.39909	0.21640	1.41182	0.22494	1.40342	0.31496	0.660	1.37658	0.01355	1.38833	0.01425	1.38007	0.01076
0.268	1.39866	0.21093	1.41137	0.21929	1.40280	0.30222	0.680	1.37632	0.01257	1.38805	0.01322	1.37986	0.01002

TABLE 36. RECOMMENDED VALUES ON THE REFRACTIVE INDEX AND ITS WAVELENGTH DERIVATIVE FOR MAGNESIUM FLUORIDE AT 293K (CONTINUED)*

λ	Ordinary Ray		Extraordinary Ray		IRTRAN 1		λ	Ordinary Ray		Extraordinary Ray		IRTRAN 1	
μm	n_o	$-dn_o/d\lambda$	n_e	$-dn_e/d\lambda$	n	-dn/dλ	μm	n_o	$-dn_o/d\lambda$	n_e	$-dn_e/d\lambda$	n	-dn/dλ
0.700	1.37604	0.01170	1.39780	0.01231	1.37967	0.00937	3.250	1.35981	0.00867	1.37022	0.00962	1.36144	0.01054
0.720	1.37585	0.01093	1.39756	0.01151	1.37948	0.00881	3.300	1.35937	0.00881	1.36975	0.00958	1.36081	0.01072
0.740	1.37564	0.01026	1.39734	0.01083	1.37931	0.00831	3.350	1.35893	0.00895	1.36927	0.00973	1.36037	0.01093
0.760	1.37544	0.00965	1.39713	0.01018	1.37915	0.00788	3.400	1.35848	0.00909	1.36878	0.00988	1.35991	0.01111
0.780	1.37526	0.00911	1.39693	0.00962	1.37900	0.00750	3.450	1.35802	0.00923	1.36828	0.01004	1.35925	0.01129
0.800	1.37509	0.00863	1.39674	0.00912	1.37885	0.00717	3.500	1.35755	0.00937	1.36777	0.01019	1.35859	0.01146
0.820	1.37491	0.00820	1.39656	0.00867	1.37871	0.00688	3.550	1.35708	0.00952	1.36726	0.01035	1.35811	0.01164
0.840	1.37475	0.00782	1.39639	0.00828	1.37858	0.00662	3.600	1.35660	0.00966	1.36674	0.01050	1.35762	0.01182
0.860	1.37460	0.00744	1.39623	0.00792	1.37845	0.00640	3.650	1.35612	0.00981	1.36621	0.01066	1.35693	0.01200
0.880	1.37445	0.00717	1.39609	0.00760	1.37832	0.00621	3.700	1.35562	0.00995	1.36567	0.01082	1.35612	0.01218
0.900	1.37431	0.00690	1.39593	0.00732	1.37820	0.00603	3.750	1.35512	0.01010	1.36513	0.01098	1.35571	0.01236
0.920	1.37418	0.00665	1.39578	0.00706	1.37808	0.00587	3.800	1.35461	0.01025	1.36457	0.01114	1.35509	0.01254
0.940	1.37404	0.00643	1.39564	0.00683	1.37796	0.00574	3.850	1.35410	0.01040	1.36401	0.01130	1.35445	0.01272
0.960	1.37392	0.00623	1.39551	0.00662	1.37785	0.00562	3.900	1.35357	0.01056	1.36344	0.01147	1.35381	0.01291
0.980	1.37380	0.00605	1.39538	0.00644	1.37774	0.00552	3.950	1.35304	0.01070	1.36287	0.01163	1.35316	0.01310
1.000	1.37368	0.00589	1.39525	0.00627	1.37763	0.00543	4.000	1.35250	0.01085	1.36228	0.01179	1.35250	0.01329
1.050	1.37339	0.00556	1.39495	0.00593	1.37736	0.00526	4.050	1.35196	0.01100	1.36169	0.01196	1.35183	0.01347
1.100	1.37312	0.00530	1.39466	0.00567	1.37710	0.00515	4.100	1.35140	0.01115	1.36109	0.01212	1.35116	0.01366
1.150	1.37286	0.00512	1.39438	0.00549	1.37684	0.00509	4.150	1.35084	0.01131	1.36047	0.01229	1.35047	0.01385
1.200	1.37261	0.00498	1.39411	0.00534	1.37659	0.00506	4.200	1.35027	0.01146	1.35985	0.01246	1.34977	0.01405
1.250	1.37236	0.00488	1.39384	0.00525	1.37634	0.00506	4.250	1.34970	0.01162	1.35923	0.01263	1.34906	0.01424
1.300	1.37212	0.00482	1.39358	0.00519	1.37608	0.00509	4.300	1.34911	0.01177	1.35859	0.01280	1.34835	0.01443
1.350	1.37188	0.00479	1.39333	0.00516	1.37583	0.00513	4.350	1.34852	0.01193	1.35795	0.01297	1.34762	0.01462
1.400	1.37164	0.00478	1.39307	0.00515	1.37557	0.00519	4.400	1.34792	0.01209	1.35730	0.01314	1.34688	0.01482
1.450	1.37140	0.00478	1.39281	0.00516	1.37531	0.00527	4.450	1.34731	0.01225	1.35663	0.01331	1.34614	0.01502
1.500	1.37116	0.00481	1.39255	0.00519	1.37504	0.00535	4.500	1.34669	0.01241	1.35596	0.01349	1.34539	0.01521
1.550	1.37092	0.00484	1.39229	0.00524	1.37477	0.00545	4.550	1.34607	0.01257	1.35529	0.01366	1.34462	0.01541
1.600	1.37067	0.00489	1.39203	0.00529	1.37450	0.00555	4.600	1.34544	0.01273	1.35460	0.01384	1.34384	0.01561
1.650	1.37043	0.00496	1.39175	0.00536	1.37422	0.00566	4.650	1.34480	0.01289	1.35390	0.01401	1.34306	0.01581
1.700	1.37019	0.00502	1.39149	0.00543	1.37393	0.00578	4.700	1.34415	0.01306	1.35320	0.01419	1.34226	0.01602
1.750	1.36993	0.00509	1.39122	0.00552	1.37364	0.00590	4.750	1.34349	0.01322	1.35248	0.01437	1.34145	0.01622
1.800	1.36967	0.00517	1.39094	0.00561	1.37334	0.00603	4.800	1.34282	0.01339	1.35176	0.01455	1.34064	0.01643
1.850	1.36941	0.00526	1.39066	0.00570	1.37304	0.00616	4.850	1.34215	0.01356	1.35103	0.01473	1.33981	0.01663
1.900	1.36914	0.00535	1.39037	0.00580	1.37273	0.00629	4.900	1.34147	0.01372	1.35029	0.01491	1.33897	0.01684
1.950	1.36887	0.00545	1.39008	0.00591	1.37241	0.00643	4.950	1.34078	0.01389	1.34954	0.01510	1.33813	0.01705
2.000	1.36860	0.00555	1.38978	0.00602	1.37208	0.00657	5.000	1.34008	0.01406	1.34878	0.01528	1.33727	0.01726
2.050	1.36832	0.00565	1.38948	0.00613	1.37175	0.00671	5.100	1.33866	0.01440	1.34723	0.01565	1.33552	0.01769
2.100	1.36804	0.00575	1.38917	0.00625	1.37141	0.00686	5.200	1.33720	0.01475	1.34565	0.01603	1.33373	0.01811
2.150	1.36774	0.00586	1.38885	0.00637	1.37107	0.00701	5.300	1.33571	0.01510	1.34402	0.01641	1.33190	0.01854
2.200	1.36745	0.00597	1.38853	0.00649	1.37071	0.00716	5.400	1.33418	0.01546	1.34235	0.01680	1.33003	0.01898
2.250	1.36715	0.00609	1.38820	0.00661	1.37035	0.00731	5.500	1.33261	0.01582	1.34066	0.01719	1.32810	0.01943
2.300	1.36684	0.00620	1.38787	0.00674	1.36998	0.00746	5.600	1.33101	0.01619	1.33893	0.01759	1.32614	0.01988
2.350	1.36653	0.00632	1.38753	0.00687	1.36960	0.00761	5.700	1.32938	0.01656	1.33715	0.01799	1.32413	0.02034
2.400	1.36621	0.00644	1.38719	0.00700	1.36922	0.00777	5.800	1.32770	0.01694	1.33533	0.01840	1.32207	0.02081
2.450	1.36588	0.00656	1.38683	0.00713	1.36883	0.00793	5.900	1.32599	0.01732	1.33347	0.01881	1.31997	0.02128
2.500	1.36555	0.00669	1.38647	0.00727	1.36841	0.00808	6.000	1.32424	0.01771	1.33156	0.01924	1.31782	0.02176
2.550	1.36521	0.00681	1.38610	0.00740	1.36802	0.00824	6.100	1.32245	0.01810	1.32962	0.01966	1.31562	0.02224
2.600	1.36487	0.00694	1.38573	0.00754	1.36760	0.00840	6.200	1.32062	0.01850	1.32763	0.02010	1.31337	0.02274
2.650	1.36452	0.00706	1.38535	0.00768	1.36715	0.00857	6.300	1.31875	0.01890	1.32560	0.02054	1.31107	0.02324
2.700	1.36416	0.00719	1.38496	0.00782	1.36675	0.00873	6.400	1.31684	0.01931	1.32352	0.02098	1.30872	0.02375
2.750	1.36380	0.00732	1.38456	0.00796	1.36631	0.00890	6.500	1.31489	0.01973	1.32140	0.02144	1.30632	0.02426
2.800	1.36343	0.00745	1.38416	0.00810	1.36586	0.00906	6.600	1.31289	0.02016	1.31924	0.02190	1.30387	0.02479
2.850	1.36306	0.00758	1.38375	0.00824	1.36540	0.00922	6.700	1.31085	0.02059	1.31702	0.02237	1.30136	0.02532
2.900	1.36267	0.00771	1.38334	0.00839	1.36493	0.00939	6.800	1.30877	0.02103	1.31476	0.02284	1.29880	0.02587
2.950	1.36229	0.00785	1.38292	0.00853	1.36444	0.00956	6.900	1.30665	0.02147	1.31245	0.02333	1.29619	0.02642
3.000	1.36189	0.00799	1.38249	0.00868	1.36394	0.00972	7.000	1.30444	0.02193	1.31010	0.02382	1.29352	0.02699
3.050	1.36149	0.00813	1.38205	0.00883	1.36343	0.00989	7.100	1.30224	0.02239	1.30767	0.02431	1.29079	0.02757
3.100	1.36108	0.00828	1.38160	0.00897	1.36289	0.01006	7.200	1.29998	0.02285	1.30523	0.02484	1.28801	0.02815
3.150	1.36066	0.00843	1.38115	0.00913	1.36234	0.01024	7.300	1.29769	0.02333	1.30272	0.02536	1.28516	0.02875
3.200	1.36024	0.00858	1.38069	0.00927	1.36177	0.01041	7.400	1.29535	0.02382	1.30016	0.02591	1.28226	0.02935

*

TABLE 36. RECOMMENDED VALUES ON THE REFRACTIVE INDEX AND ITS WAVELENGTH DERIVATIVE FOR MAGNESIUM FLUORIDE AT 293K (CONTINUED)*

λ	Ordinary Ray		Extraordinary Ray		IRTRAN 1		λ	Ordinary Ray		Extraordinary Ray		IRTRAN 1	
μm	n_o	$-dn_o/d\lambda$	n_e	$-dn_e/d\lambda$	n	-dn/dλ	μm	n_o	$-dn_o/d\lambda$	n_e	$-dn_e/d\lambda$	n	-dn/dλ
7.500	1.29233	0.02431	1.29754	0.02643	1.27930	0.02994	8.800	1.25674	0.03168	1.25817	0.03451	1.23466	0.03913
7.600	1.29047	0.02482	1.29447	0.02698	1.27627	0.03057	8.900	1.25354	0.03234	1.25468	0.03523	1.23071	0.03995
7.700	1.28796	0.02533	1.29215	0.02754	1.27318	0.03120	9.000	1.25027	0.03300	1.25112	0.03597	1.22667	0.04078
7.800	1.28541	0.02585	1.28937	0.02811	1.27003	0.03185	9.100	1.24694	0.03366	1.24749	0.03673	1.22255	0.04164
7.900	1.28279	0.02638	1.28653	0.02869	1.26681	0.03252	9.200	1.24353	0.03438	1.24378	0.03750	1.21834	0.04252
8.000	1.28013	0.02693	1.28363	0.02929	1.26353	0.03319	9.300	1.24006	0.03510	1.23999	0.03829	1.21405	0.04341
8.100	1.27741	0.02748	1.28067	0.02989	1.26017	0.03388	9.400	1.23651	0.03583	1.23612	0.03910	1.20966	0.04433
8.200	1.27463	0.02804	1.27765	0.03051	1.25675	0.03459	9.500	1.23289	0.03657	1.23217	0.03993	1.20518	0.04527
8.300	1.27180	0.02862	1.27457	0.03114	1.25326	0.03530	9.600	1.22920	0.03734	1.22813	0.04079	1.20061	0.04624
8.400	1.26891	0.02921	1.27142	0.03179	1.24969	0.03604	9.700	1.22542	0.03812	1.22401	0.04166	1.19593	0.04722
8.500	1.26596	0.02981	1.26821	0.03245	1.24605	0.03679	9.800	1.22157	0.03893	1.21980	0.04256	1.19116	0.04824
8.600	1.26295	0.03042	1.26493	0.03312	1.24233	0.03755	9.900	1.21764	0.03975	1.21549	0.04348	1.18629	0.04928
8.700	1.25987	0.03104	1.26159	0.03381	1.23854	0.03833	10.000	1.21362	0.04060	1.21110	0.04443	1.18130	0.05035

*IN THIS TABLE MORE DECIMAL PLACES ARE REPORTED THAN WARRANTED MERELY FOR THE PURPOSE OF TABULAR SMOOTHNESS AND INTERNAL COMPARISON. FOR UNCERTAINTIES OF TABULATED VALUES IN VARIOUS WAVELENGTH RANGES, SEE THE TEXT OF SUBSECTION 3.4.

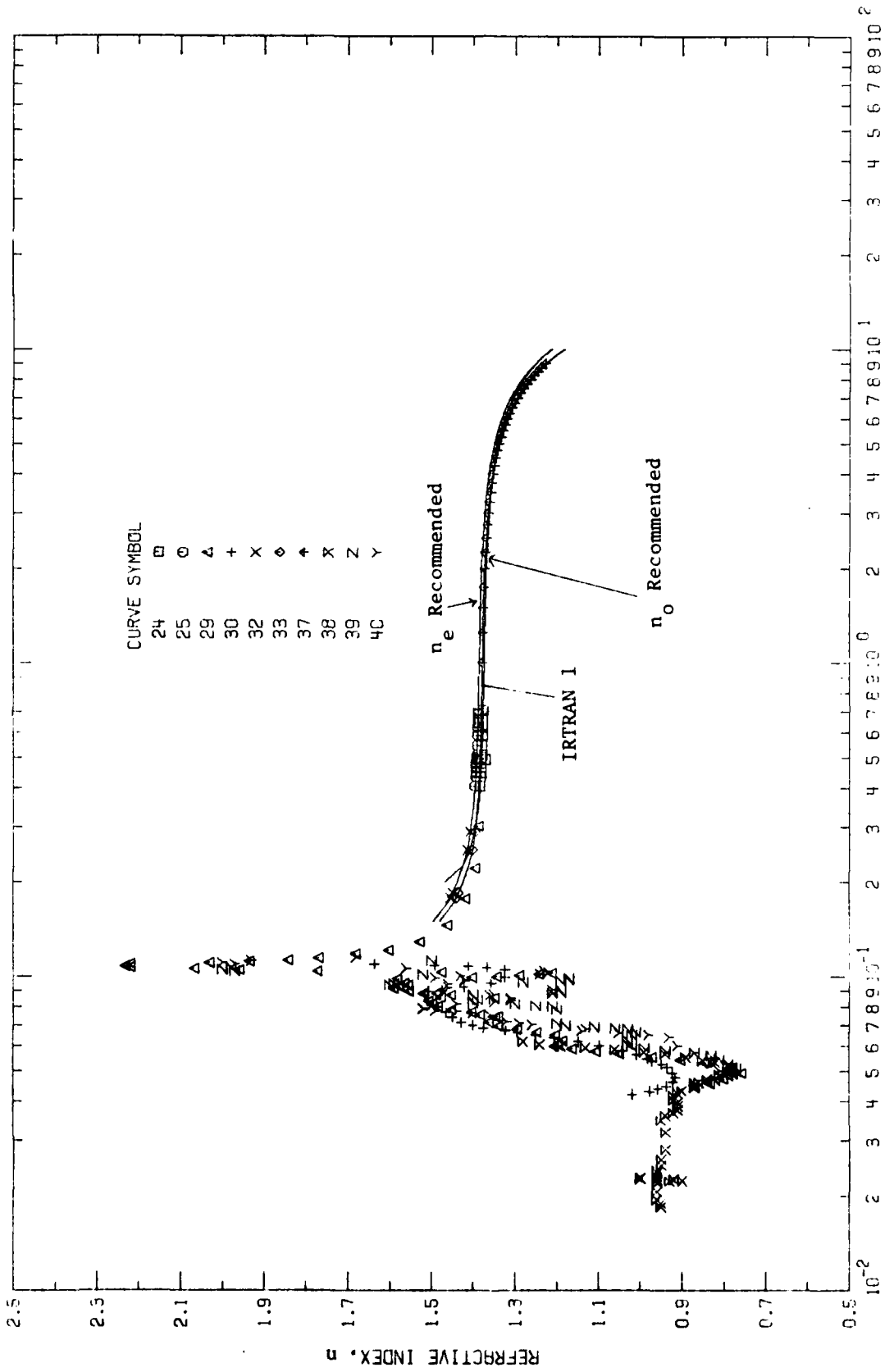


FIGURE 21. REFRACTIVE INDEX OF MAGNESIUM FLUORIDE (WAVELENGTH DEPENDENCE).

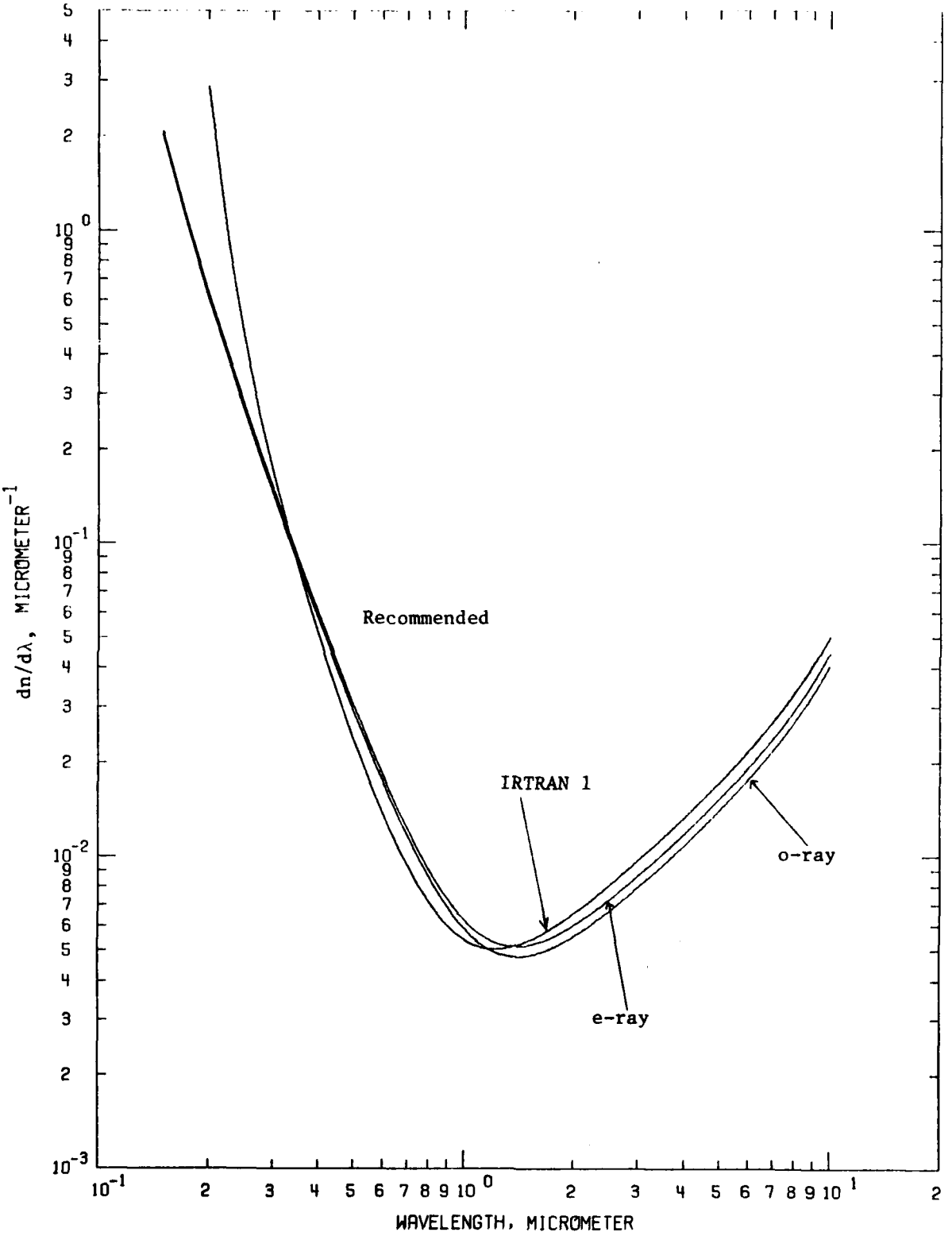


FIGURE 22. WAVELENGTH DERIVATIVE OF REFRACTIVE INDEX OF MAGNESIUM FLUORIDE.

TABLE 37. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF MAGNESIUM FLUORIDE (WAVELENGTH DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	69	ROOD, J.L.	1949	R	0.47-0.62	293	THIN FILM SPECIMEN OF VARIOUS THICKNESSES ON GLASS SUBSTRATE; REFRACTIVE INDEX DETERMINED BY NEAR NORMAL REFLECTION MEASUREMENT; IT WAS FOUND THAT THE INDEX OF REFRACTION OF FILMS WERE LOWER THAN THAT OF BULK MATERIAL AND CHANGING WITH AGE OF THE FILM; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF INDEX ONE UNIT OF THE THIRD DECIMAL PLACE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
2	70	SCHULZ, L.G. SCHEIBNER, E.J.	1958	L	0.589	293	THIN FILM SPECIMEN OF VARIOUS THICKNESSES ON GLASS SUBSTRATE WITH SILVER OR GOLD LAYER; IT WAS FOUND THAT THE INDEX OF REFRACTION IN THE FILMS WAS THE SAME AS THAT OF THE BULK MATERIALS; TEMPERATURE NOT GIVEN, 293K ASSUMED.
3	71	MORITA, N.	1952	T	0.49-0.62	293	THIN FILM SPECIMEN; VACUUM DEPOSITED ON A GLASS SUBSTRATE; REFRACTIVE INDEX DETERMINED BY TRANSMISSION METHOD FOR 4 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF INDEX AT THE THIRD DECIMAL PLACE.
4	71	MORITA, N.	1952	T	0.49-0.58	293	SIMILAR TO ABOVE BUT FOR THE SUBSTRATE TEMPERATURE AT 493K DURING DEPOSITION.
5	71	MORITA, N.	1952	T	0.58	293	SIMILAR TO ABOVE BUT FOR HIGHER SUBSTRATE TEMPERATURE.
6	72	HALL, J.E. JR. FERGUSON, W.F.C.	1954	I	0.42-0.76	293	VACUUM DEPOSITED; THIN FILM SPECIMEN OF 0.2-0.8 MICROMETER ON BLACK GLASS SUBSTRATE; AGED IN AIR FOR ONE HOUR AT 293K; REFRACTIVE INDEX DETERMINED BY INTERFERENCE METHOD; DATA EXTRACTED FROM A SMOOTH CURVE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
7	72	HALL, J.E.JR. ET AL.	1954	I	0.42-0.76	293	SIMILAR TO ABOVE BUT FOR THE FILMS AGED FOR ONE WEEK.
8	73	JENNESS, J.R.JR.	1956	T	2.0	293	SINGLE CRYSTAL; VACUUM DEPOSITED; THIN FILM SPECIMEN OF 0.5 MICROMETER ON FUSED QUARTZ SUBSTRATE; REFRACTIVE INDEX DETERMINED BY TRANSMISSION METHOD FOR THE SPECTRAL LINE 2.0 MICROMETERS; TEMPERATURE NOT GIVEN, 293K ASSUMED.
9	74	MORITA, N.	1956	I	0.37-0.60	293	THIN FILM SPECIMEN OF 533 MICROMETER ON CROWN GLASS SUBSTRATE; VACUUM DEPOSITED; REFRACTIVE INDEX DETERMINED BY INTERFERENCE METHOD; DATA EXTRACTED FROM A FIGURE; UNCERTAINTY OF INDEX 0.01.
10	74	MORITA, N.	1956	I	0.37-0.60	293	SIMILAR TO ABOVE BUT FOR THIN FILM SPECIMEN OF 534 MICROMETER ON FUSED QUARTZ SUBSTRATE.

TABLE 37. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF MAGNESIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
11	74	MORITA,N.	1956	I	0.39-0.56	293	SIMILAR TO ABOVE EUT FOR THIN FILM SPECIMEN OF 697 MICROMETER ON CROWN GLASS SUBSTRATE.
12	74	MORITA,N.	1956	I	0.39-0.54	293	SIMILAR TO ABOVE EUT FOR THIN FILM SPECIMEN OF 687 MICROMETER ON FUSED QUARTZ SUBSTRATE.
13	74	MORITA,N.	1956	I	0.37-0.55	293	SIMILAR TO ABOVE EUT FOR THIN FILM SPECIMEN OF 395 MICROMETER ON FUSED QUARTZ SUBSTRATE.
14	74	MORITA,N.	1956	I	0.397,0.489	293	SIMILAR TO ABOVE EUT FOR THIN FILM SPECIMEN OF 350 MICROMETER ON CROWN GLASS SUBSTRATE.
15	74	MORITA,N.	1956	I	0.38-0.50	293	SIMILAR TO ABOVE BUT FOR THIN FILM SPECIMEN OF 596 MICROMETER ON CROWN GLASS SUBSTRATE; KEPT AT TEMPERATURE 513 K DURING DEPOSITION.
16	74	MORITA,N.	1956	I	0.39-0.59	293	SIMILAR TO ABOVE EUT FOR THIN FILM SPECIMEN OF 610 MICROMETER ON FUSED QUARTZ SUBSTRATE; KEPT AT 513 K DURING DEPOSITION.
17	74	MORITA,N.	1956	I	0.38-0.56	293	SIMILAR TO ABOVE EUT FOR THIN FILM SPECIMEN OF 829 MICROMETER ON CROWN GLASS SUBSTRATE; KEPT AT 673 K DURING DEPOSITION.
18	74	MORITA,N.	1956	I	0.34-0.53	293	SIMILAR TO ABOVE EUT FOR THIN FILM SPECIMEN OF 829 MICROMETER ON FUSED QUARTZ SUBSTRATE; KEPT AT 673 K DURING DEPOSITION.
19	74	MORITA,N.	1956	I	0.408,0.508	293	SIMILAR TO ABOVE BUT FOR THIN FILM SPECIMEN OF 1090 MICROMETER ON CROWN GLASS SUBSTRATE; KEPT AT 623 K DURING DEPOSITION.
20	74	MORITA,N.	1956	I	0.42-0.58	293	SIMILAR TO ABOVE BUT FOR THIN FILM SPECIMEN OF 1095 MICROMETER ON FUSED QUARTZ SUBSTRATE; KEPT AT 623 K DURING DEPOSITION.
21	74	MORITA,N.	1956	I	0.39-0.58	293	SIMILAR TO ABOVE EUT FOR THIN FILM SPECIMEN OF 358 MICROMETER ON FUSED QUARTZ SUBSTRATE; KEPT AT 623 K DURING DEPOSITION.
22	74	MORITA,N.	1956	I	0.38-0.56	293	SIMILAR TO ABOVE EUT FOR THIN FILM SPECIMEN OF 470 MICROMETER ON CROWN GLASS SUBSTRATE; KEPT AT 593 K DURING DEPOSITION.
23	74	MORITA,N.	1956	I	0.34-0.51	293	SIMILAR TO ABOVE EUT FOR THIN FILM SPECIMEN OF 362 MICROMETER ON CROWN GLASS SUBSTRATE; KEPT AT 623 K DURING DEPOSITION.

TABLE 37. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF MAGNESIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
24	18	DUNCANSON,A. STEVENSON,R.W.H.	1958	D	0.40-0.71	294	SYNTHETIC CRYSTAL; GROWN BY THE STOCKBARGER TECHNIQUE; PRISMATIC SPECIMEN; NEAR 60 DEGREE APEX ANGLE, 25MMX27MM VIEW SURFACE; REFRACTIVE INDEX DETERMINED BY DEVIATION METHOD FOR 18 ORDINARY SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; A HARTMANN INTERPOLATION FORMULA BEST FIT THE RESULTS ALSO GIVEN.
25	18	DUNCANSON,A. ET AL.	1958	D	0.40-0.71	294	SIMILAR TO ABOVE BUT FOR EXTRAORDINARY RAY.
26	75	COLE,T.T. OPPENHEIMER,F.	1962	R	0.03-0.13	293	THIN FILM SPECIMEN OF UNSPECIFIED THICKNESS; VACUUM DEPOSITED; 10,30,50 AND 70 DEGREE INCIDENT REFLECTION SPECTRUM OBTAINED; REFRACTIVE INDEX DEDUCED FROM REFLECTION SPECTRUM WITH FRESNEL FORMULAE; DATA EXTRACTED FROM A TABLE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
27	63	LUKIRSKII,A.P. SAVINOV,E.P. ERSHOV,O.A. SHEPELEV,YU.F.	1964	R	0.002-0.12	298	THIN FILM SPECIMEN OF MAGNESIUM FLUORIDE ON GOLD OR ALUMINIUM SUBSTRATE; REFRACTIVE INDEX DEDUCED FROM REFLECTION SPECTRUM WITH FRESNEL FORMULAE; DATA EXTRACTED FROM A TABLE.
28	49	FABRE,D. ROMAND,J. VODAR,B.	1964	R	0.08-0.17	293	THIN FILM SPECIMEN OF VARYING THICKNESS; VACUUM DEPOSITED; REFRACTIVE INDEX DETERMINED BY REFLECTANCE OF VARYING THICKNESS; DATA EXTRACTED FROM A FIGURE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
29	76	WILLIAMS,M.W.	1967	R	0.04-0.30	293	SINGLE CRYSTAL; OBTAINED FROM OPTOVAC, INC.; PLATE SPECIMEN; 1MM THICK; HIGHLY POLISHED SURFACES; FOR WAVELENGTH REGION 0.1-0.3 MICROMETER NEAR NORMAL AND 75 DEGREE INCIDENT REFLECTION SPECTRUM OBTAINED; FOR REGION 0.04-0.13 MICROMETER 20, 70 AND 75 DEGREE INCIDENT REFLECTION SPECTRUM OBTAINED; REFRACTIVE INDEX DEDUCED FROM REFLECTION SPECTRUM WITH FRESNEL FORMULAE; DATA EXTRACTED FROM A SMOOTH CURVE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
30	76	WILLIAMS,M.W.	1967	R	0.04-0.11	293	SINGLE CRYSTAL; VACUUM DEPOSITED; THIN FILM SPECIMEN OF UNKNOWN THICKNESS; 20 AND 70 DEGREE INCIDENT REFLECTION SPECTRUM OBTAINED; REFRACTIVE INDEX DEDUCED FROM REFLECTION SPECTRUM WITH FRESNEL FORMULAE; DATA EXTRACTED FROM A SMOOTH CURVE; TEMPERATURE NOT GIVEN, 293K ASSUMED.

TABLE 37. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF MAGNESIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
31	51	HEITMANN,H. KOPPELMANN,G.	1967	L	0.6328	293	SINGLE CRYSTAL; HIGH PURITY; PRODUCTION OF SCHUCHARDT CO.; VACUUM DEPOSITED; THIN FILM SPECIMEN OF QUARTER WAVELENGTH ALTERNATE WITH ZNS AND ZNSE FILMS; REFRACTIVE INDEX DETERMINED BY MULTILAYER METHOD FOR 1 SPECTRAL LINE ; DATA EXTRACTED FROM A TABLE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
32	77	STEINMETZ,D.L. PHILLIPS,W.G. MIRICK,M. FORBES,F.F.	1967		0.17-0.29	293	SINGLE CRYSTAL; THE AUTHOR OBTAINED THE DATA THROUGH PRIVATE COMMUNICATION; DETAILS OF EXPERIMENT NOT GIVEN; REFRACTIVE INDEX OF EXTRAORDINARY RAYS FOR 4 SPECTRAL LINES WERE GIVEN; DATA EXTRACTED FROM A TABLE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
33	77	STEINMETZ,D.L. ET AL.	1967		0.17-0.29	293	SIMILAR TO ABOVE BUT FOR ORDINARY RAYS.
34	78	NAGATA,K.	1968	A	0.45-0.65	293	THIN FILM SPECIMEN OF 0.05 TO 0.10 MICROMETER ON GLASS SUBSTRATE; VACUUM DEPOSITED; REFRACTIVE INDEX DETERMINED BY ABELES METHOD FOR 3 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
35	79	MASS,G. RAMSEY,J.B.	1969	I	0.16-0.56	293	THIN FILM SPECIMEN OF UNSPECIFIED THICKNESS BY VACUUM DEPOSITION ONTO QUARTZ PLATE BY A CO_2 LASER; REFRACTIVE INDEX DETERMINED BY INTERFERENCE METHOD; DATA EXTRACTED FROM A SMOOTH CURVE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
36	80	SHKLYAREVSKII,I.N. EL-SHAZLI,A.F.A. GOVORUSHCHENKO,A.I.	1971	I	0.40-1.00	293	VACUUM DEPOSITED; THIN FILM SPECIMEN OF 0.133 TO 0.517 MICROMETER ON GLASS SUBSTRATE; 3MMX1.2MM AREA; REFRACTIVE INDEX DETERMINED BY INTERFERENCE METHOD; DATA EXTRACTED FROM A SMOOTH CURVE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
37	20	EASTMAN KODAK CO.	1971	D	1.00-9.00	293	POLYCRYSTALLINE; KODAK INFRARED OPTICAL MATERIAL IRTRAN 1; DESCRIPTION OF SPECIMEN AND EXPERIMENT NOT GIVEN; TEMPERATURE NOT GIVEN, 293K ASSUMED; DATA EXTRACTED FROM A TABLE COMPUTED BY A GIVEN HERZBERGER DISPERSION EQUATION.
38	81	HANSON,W.F. ARAKAWA,E.T. WILLIAMS,M.W.	1972	R	0.015-0.06		SINGLE CRYSTAL; OBTAINED FROM ALPHA INORGANICS, INC.; POLISHED WITH 0.5 MICROMETER GRIT; 12 ANGLES FROM 20 TO 75 DEGREES INCIDENT REFLECTION SPECTRUM OBTAINED; REFRACTIVE INDEX DEDUCED FROM REFLECTION SPECTRUM WITH FRESNEL FORMULAE; DATA EXTRACTED FROM A FIGURE; TEMPERATURE NOT GIVEN, 293K ASSUMED.

TABLE 37. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF MAGNESIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
39	82	THOMAS,J. STEPMAN,G. LEMONNIER,J.C. NISAR,M., ROBIN,S.	1973	R	0.04-0.12	293	SINGLE CRYSTAL; OBTAINED FROM THE HARSHAW CHEMICAL CO.; DISC SPECIMEN; WITH OPTICAL AXIS PARALLEL TO THE POLISHED FACES; REFLECTANCE MEASURED AT VARIOUS INCIDENT ANGLES FROM 25 TO 55 DEGREES; REFRACTIVE INDEX OF ORDINARY-RAY DEDUCED FROM REFLECTION SPECTRUM; DATA EXTRACTED FROM A FIGURE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
40	82	THOMAS,J. ET AL.	1973	R	0.04-0.12	293	SIMILAR TO ABOVE BUT FOR EXTRAORDINARY-RAY.
41	83	YADAVA,V.N. SHARMA,S.K. CHOPRA,K.L.	1974	L	0.20,0.70	293	THIN FILM SPECIMEN OF PURE MAGNESIUM FLUORIDE ON QUARTZ SUBSTRATE; VACUUM DEPOSITED; REFRACTIVE INDEX DETERMINED BY DEDUCTION OF THE REFLECTANCE AND TRANSMITTANCE OF THE FILM; DIGITIZED VALUES OF REFRACTIVE INDEX GIVEN; TEMPERATURE NOT GIVEN, 293K ASSUMED.

TABLE 38. EXPERIMENTAL REFRACTIVE INDEX OF MAGNESIUM FLUORIDE (WAVELENGTH DEPENDENCE)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n)

λ	n
DATA SET 1	
T = 293.0	
0.47	1.339
0.50	1.337
0.52	1.343
0.54	1.322
0.54	1.336
0.54	1.337
0.54	1.358
0.55	1.357
0.55	1.363
0.55	1.377
0.56	1.346
0.57	1.352
0.57	1.362
0.58	1.349
0.60	1.346
DATA SET 2	
T = 293.0	
0.589	1.39
DATA SET 3	
T = 293.0	
0.49	1.391
0.52	1.386
0.56	1.387
0.62	1.387
DATA SET 4	
T = 293.0	
0.49	1.366
0.56	1.387
0.58	1.376

λ	n
DATA SET 5	
T = 293.0	
0.58	1.360
DATA SET 6	
T = 293.0	
0.426	1.375
0.441	1.373
0.458	1.372
0.476	1.371
0.494	1.369
0.513	1.369
0.538	1.368
0.562	1.367
0.605	1.367
0.674	1.366
0.710	1.366
0.752	1.366
DATA SET 7	
T = 293.0	
0.425	1.399
0.442	1.397
0.458	1.396
0.482	1.395
0.508	1.394
0.537	1.393
0.566	1.392
0.597	1.391
0.626	1.391
0.659	1.390
0.701	1.390
0.756	1.390
DATA SET 8	
T = 293.0	
2.0	1.36

λ	n
DATA SET 9	
T = 293.0	
0.379	1.428
0.430	1.418
0.501	1.409
0.601	1.408
DATA SET 10	
T = 293.0	
0.373	1.408
0.424	1.390
0.499	1.400
0.592	1.388
DATA SET 11	
T = 293.0	
0.395	1.420
0.431	1.401
0.493	1.419
0.560	1.407
DATA SET 12	
T = 293.0	
0.391	1.428
0.430	1.414
0.491	1.426
0.539	1.400
DATA SET 13	
T = 293.0	
0.371	1.414
0.440	1.412
0.551	1.392

λ	n
DATA SET 14	
T = 293.0	
0.397	1.416
0.489	1.403
DATA SET 15	
T = 293.0	
0.383	1.445
0.430	1.431
0.500	1.460
DATA SET 16	
T = 293.0	
0.395	1.424
0.427	1.411
0.471	1.424
0.528	1.425
0.590	1.419
DATA SET 17	
T = 293.0	
0.386	1.409
0.412	1.417
0.439	1.411
0.474	1.413
0.516	1.418
0.563	1.419
DATA SET 18	
T = 293.0	
0.341	1.432
0.377	1.410
0.439	1.409
0.530	1.416

λ	n
DATA SET 19	
T = 293.0	
0.408	1.406
0.508	1.402
DATA SET 20	
T = 293.0	
0.421	1.377
0.500	1.434
0.575	1.416
DATA SET 21	
T = 293.0	
0.398	1.430
0.432	1.426
0.470	1.410
0.527	1.418
0.585	1.403
DATA SET 22	
T = 293.0	
0.381	1.387
0.413	1.410
0.435	1.390
0.473	1.406
0.503	1.384
0.560	1.406
DATA SET 23	
T = 293.0	
0.341	1.429
0.409	1.415
0.510	1.411

λ	n
DATA SET 24	
T = 294.0	
0.404656	1.38359
0.434046	1.38215
0.435835	1.38207
0.447148	1.38160
0.467816	1.38082
0.479992	1.38039
0.492193	1.37001
0.501568	1.37972
0.508582	1.37953
0.546074	1.37859
0.587562	1.37774
0.58937	1.37770
0.623437	1.37713
0.643847	1.37681
0.656279	1.37662
0.667815	1.37647
0.690716	1.37618
0.706525	1.37599
DATA SET 25	
T = 294.0	
0.404656	1.39566
0.434046	1.39415
0.435835	1.39407
0.447148	1.39357
0.467816	1.39275
0.479992	1.39231
0.492193	1.39192
0.501568	1.39163
0.508582	1.39142
0.546074	1.39043
0.587562	1.38954
0.58937	1.38950
0.623437	1.38859
0.643847	1.38858
0.656279	1.38838
0.667815	1.38822
0.690716	1.38790

TABLE 38. EXPERIMENTAL REFRACTIVE INDEX OF MAGNESIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n)

λ	n
DATA SET 25(CONT.)	
0.7065525	1.38771
DATA SET 26	
T = 293.0	
0.0304	0.93
0.0584	0.93
0.0928	1.03
0.1048	1.20
0.1216	1.30
DATA SET 27	
T = 298.0	
0.00236	0.99855
0.00314	0.99803
0.0044	0.99734
0.0067	0.99510
0.0113	0.9800
DATA SET 28	
T = 293.0	
0.0924	1.66
0.0950	1.96
0.0998	1.50
0.0976	1.48
0.0991	1.51
0.1034	1.77
0.1071	2.03
0.1081	2.08
0.1087	2.10
0.1099	2.09
0.1112	2.05
0.1129	1.97
0.1181	1.87
0.1224	1.79
0.1303	1.69
0.1386	1.62
0.1489	1.57
0.1568	1.54
0.1618	1.54
DATA SET 29	
T = 293.0	
0.0447	0.870
0.0457	0.833
0.0471	0.802
0.0492	0.759
0.0512	0.780
0.0532	0.847
0.0541	0.904
0.0553	0.972
0.0566	1.051
0.0576	1.106
0.0587	1.163
0.0599	1.206
0.0607	1.196
0.0623	1.185
0.0649	1.204
0.0663	1.248
0.0677	1.295
0.0696	1.341
0.0716	1.363
0.0742	1.347
0.0746	1.341
0.0756	1.385
0.0770	1.406
0.0784	1.453
0.0805	1.485
0.0821	1.499
0.0837	1.508
0.0861	1.479
0.0873	1.454
0.0885	1.488
0.0885	1.520
0.0898	1.554
0.0918	1.591
0.0932	1.577
0.0939	1.557
0.0953	1.565
0.0984	1.583
0.0992	1.404
0.1000	1.344
0.1008	1.290
0.1016	1.243
0.1024	1.212
0.1033	1.477
0.1042	1.773
0.1050	1.960
0.1059	2.068
0.1068	2.221
0.1078	2.233
0.1097	2.221
0.1107	2.031
0.1117	1.935
0.1127	1.844
0.1148	1.770
0.1180	1.682
0.1215	1.603
0.1291	1.529
0.1459	1.463
0.1771	1.420
0.2214	1.397
0.3024	1.388
DATA SET 30	
T = 293.0	
0.0421	1.018
0.0430	0.977
0.0438	0.957
0.0447	0.937
0.0460	0.921
0.0476	0.915
0.0492	0.922
0.0512	0.934
0.0525	0.949
0.0536	0.971
0.0546	0.982
0.0563	1.008
0.0579	1.043
0.0601	1.097
0.0620	1.147
0.0639	1.205
0.0652	1.249
0.0663	1.293
0.0673	1.322
0.0685	1.375
0.0700	1.401
0.0716	1.429
0.0742	1.450
0.0770	1.465
0.0800	1.485
0.0837	1.509
0.0873	1.516
0.0898	1.507
0.0905	1.474
0.0925	1.422
0.0953	1.357
0.0992	1.324
0.1050	1.324
0.1068	1.366
0.1078	1.411
0.1087	1.492
0.1097	1.636
DATA SET 31	
T = 293.0	
0.6328	1.33
DATA SET 32	
T = 293.0	
0.1780	1.45365
0.1850	1.44797
0.2536	1.41483
0.2893	1.4073
DATA SET 33	
T = 293.0	
0.1780	1.43975
0.1850	1.43424
0.2536	1.40208
0.2893	1.39485
DATA SET 34	
T = 293.0	
0.450	1.390
0.550	1.387
0.650	1.385
DATA SET 35	
T = 293.0	
0.160	1.473
0.164	1.467
0.170	1.459
0.178	1.451
0.186	1.444
0.194	1.438
0.204	1.433
0.216	1.427
0.230	1.422
0.242	1.418
0.257	1.414
0.273	1.411
0.293	1.407
0.312	1.404
0.331	1.400
0.350	1.398
0.373	1.395
0.399	1.393
0.422	1.391
0.445	1.390
0.473	1.389
0.494	1.388
0.517	1.387
0.541	1.387
0.560	1.384
DATA SET 36	
T = 293.0	
0.410	1.3999
0.600	1.3993
0.800	1.3982
1.020	1.3969
DATA SET 37	
T = 293.0	
1.0000	1.3778
1.2500	1.3763
1.5000	1.3749
1.7500	1.3735
2.0000	1.3720
2.2500	1.3702
2.5000	1.3683
2.7500	1.3663
3.0000	1.3640
3.2500	1.3614
3.5000	1.3587
3.7500	1.3558
4.0000	1.3526
4.2500	1.3492
4.5000	1.3455
4.7500	1.3416
5.0000	1.3374
5.2500	1.3329
5.5000	1.3282
5.7500	1.3232
6.0000	1.3179
6.2500	1.3122
6.5000	1.3063
6.7500	1.3000
7.0000	1.2934
7.2500	1.2865
7.5000	1.2792

TABLE 38. EXPERIMENTAL REFRACTIVE INDEX OF MAGNESIUM FLUORIDE (WAVELENGTH DEPENDENCE) (CONTINUED)

(WAVELENGTH, , ; TEMPERATURE, T, K; REFRACTIVE INDEX ,

λ	n
DATA SET 37(CONT.)	
7.7500	1.2715
8.0000	1.2634
8.2500	1.2549
8.5000	1.2460
8.7500	1.2367
9.0000	1.2269
DATA SET 38 T = 293.0	
0.0185	0.95
0.0190	0.95
0.0195	0.96
0.0207	0.96
0.0221	0.96
0.0223	0.93
0.0224	0.90
0.0226	0.92
0.0228	0.96
0.0227	1.00
0.0229	1.00
0.0231	0.96
0.0237	0.96
0.0241	0.96
0.0250	0.95
0.0261	0.95
0.0281	0.94
0.0319	0.94
0.0348	0.95
0.0361	0.94
0.0369	0.92
0.0376	0.91
0.0387	0.91
0.0397	0.91
0.0403	0.92
0.0418	0.92
0.0424	0.91
0.0432	0.90
0.0441	0.87
0.0452	0.87
0.0460	0.86
0.0471	0.84
0.0480	0.81
0.0492	0.79
0.0500	0.78
0.0508	0.78
0.0518	0.79
0.0532	0.82
0.0539	0.85
0.0553	0.89
0.0566	0.94
0.0574	0.99
0.0584	1.06
0.0593	1.13
0.0599	1.19
0.0607	1.24
0.0620	1.28
DATA SET 39 T = 293.	
0.0459	0.84
0.0468	0.82
0.0482	0.79
0.0491	0.78
0.0499	0.77
0.0511	0.77
0.0527	0.79
0.0544	0.81
0.0558	0.83
0.0571	0.87
0.0581	0.94
0.0591	0.99
0.0599	1.02
0.0608	1.03
0.0627	1.03
0.0650	1.02
0.0663	1.01
0.0677	1.03
0.0683	1.06
0.0691	1.11
0.0699	1.18
0.0709	1.20
0.0784	1.20
0.0802	1.21
0.0808	1.25
0.0817	1.30
0.0826	1.40
0.0837	1.40
0.0842	1.39
0.0848	1.35
0.0853	1.35
0.0867	1.40
0.0875	1.40
0.0887	1.21
0.0890	1.19
0.0904	1.19
0.0933	1.58
0.0942	1.60
0.0950	1.59
0.0961	1.28
0.0964	1.19
0.0975	1.17
0.0985	1.17
0.1014	1.52
0.1044	1.97
0.1054	2.00
0.1068	1.98
0.1125	1.50
DATA SET 40 T = 293.	
0.0457	0.87
0.0470	0.84
0.0486	0.81
0.0500	0.81
0.0528	0.83
0.0571	0.87
0.0602	0.91
0.0641	0.93
0.0650	0.98
0.0659	1.05
0.0670	1.14
0.0680	1.13
0.0702	1.26
0.0711	1.29
0.0720	1.32
0.0753	1.36
0.0767	1.40
0.0774	1.44
0.0781	1.49
0.0788	1.52
0.0794	1.52
0.0808	1.50
0.0819	1.44
0.0830	1.35
0.0842	1.31
0.0855	1.31
0.0872	1.36
0.0877	1.35
0.0887	1.21
0.0907	1.21
0.0923	1.46
0.0946	1.46
0.0970	1.42
0.0979	1.42
0.0991	1.49
0.1004	1.43
0.1018	1.24
0.1029	1.22
0.1040	1.23
0.1064	1.56
0.1093	1.97
0.1105	2.00
0.1126	1.93
0.1154	1.68
DATA SET 41 T = 293.0	
0.28	1.43
0.70	1.37

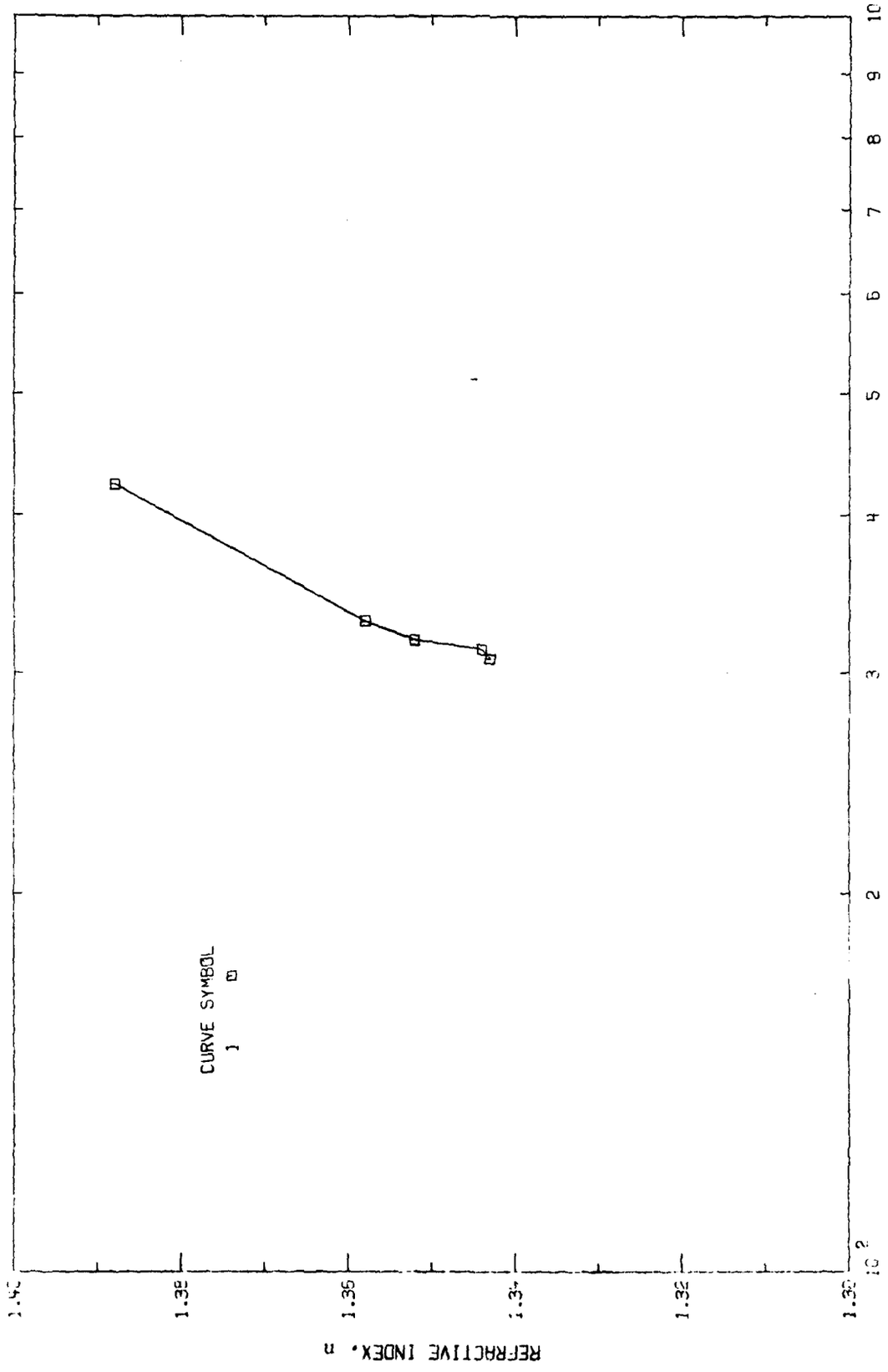


FIGURE 23. REFRACTIVE INDEX OF MAGNESIUM FLUORIDE (TEMPERATURE DEPENDENCE).

TABLE 39. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF MAGNESIUM FLUORIDE (TEMPERATURE DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	84	HACMAN, D.	1970	R	0.6328	303-573	THIN FILM SPECIMEN OF QUARTER WAVELENGTH ON GLASS SUBSTRATE AT TEMPERATURES BETWEEN 303 TO 573 K; REFRACTIVE INDEX DETERMINED BY USING THE BAUER FORMULA; DATA EXTRACTED FROM A FIGURE.

TABLE 40. EXPERIMENTAL REFRACTIVE INDEX OF MAGNESIUM FLUORIDE (TEMPERATURE DEPENDENCE)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n)

T	n
DATA SET 1	
λ = 0.632	
307.8	1.343
313.1	1.344
318.6	1.352
329.9	1.358
423.4	1.389
463.0	1.413
466.7	1.410
493.7	1.404
518.9	1.403
532.6	1.415

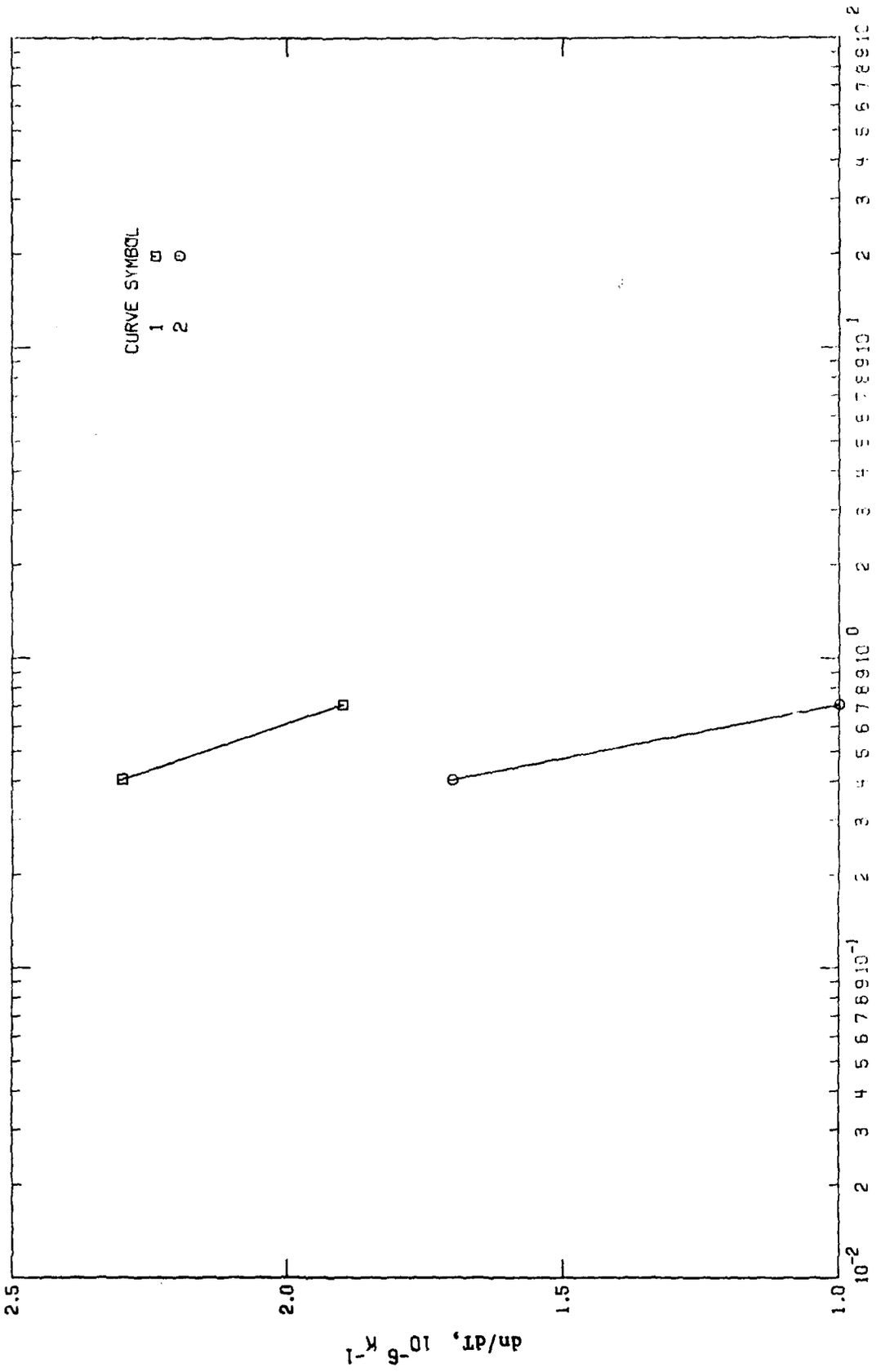


FIGURE 24. TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF MAGNESIUM FLUORIDE (WAVELENGTH DEPENDENCE).

TABLE 41. MEASUREMENT INFORMATION ON THE TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF MAGNESIUM FLUORIDE (WAVELENGTH DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	18	DUNCANSON,A. STEVENSON,R.W.H.	1958	D	0.40,0.70	301	SYNTHETIC CRYSTAL; GROWN BY THE STOCKBARGER TECHNIQUE; PRISMATIC SPECIMEN; NEAR 60 DEGREE APEX ANGLE, 25MMX27MM VIEW SURFACE; REFRACTIVE INDEX DETERMINED BY DEVIATION METHOD; DN/DT DETERMINED FOR ORDINARY RAY OF 2 SPECTRAL LINES SPECTRAL LINES USING THE INDICES MEASURED AT 292 AND 310K; DATA EXTRACTED FROM A TABLE.
2	18	DUNCANSON,A. ET AL.	1958	D	0.40,0.70	301	SIMILAR TO ABOVE BUT FOR EXTRAORDINARY RAY.

TABLE 42. EXPERIMENTAL TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF MAGNESIUM FLUORIDE (WAVELENGTH DEPENDENCE)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX , dn/dT, 10^{-6} K^{-1})

λ	dn/dT
DATA SET 1	
T = 301.0	
0.4047	2.3
0.7065	1.9
DATA SET 2	
T = 301.0	
0.4047	1.7
0.7065	1.8

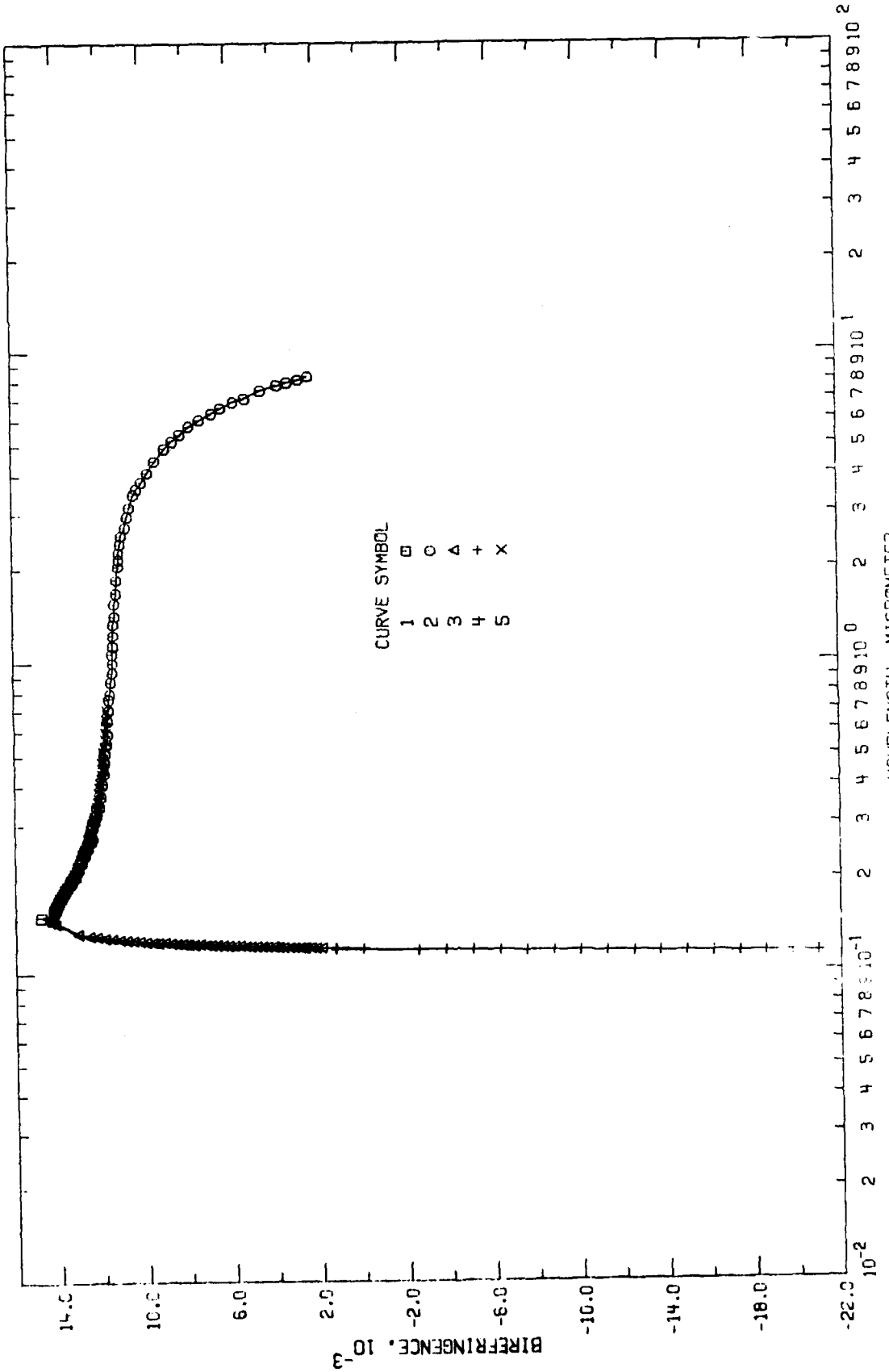


FIGURE 25. BIREFRINGENCE OF MAGNESIUM FLUORIDE (WAVELENGTH DEPENDENCE).

TABLE 43. MEASUREMENT INFORMATION ON THE BIREFRINGENCE OF MAGNESIUM FLUORIDE (WAVELENGTH DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	85	CHANDRASEKHAREN,V. DAMANY,H.	1968	I	0.15-0.34	293	SYNTHETIC CRYSTAL; PLATE SPECIMEN; 0.493MM THICK; BIREFRINGENECE CETERMINED BY INTERFERENCE METHOD FOR 30 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE.
2	86	PALIK,E.D.	1968	C	0.20-8.50	293	SYNTHETIC CRYSTAL; OBTAINED FROM OPTOVAC INC.; PLATE SPECIMEN; 2.040CMX2.040CM AREA; 0.3252CM THICK; BIREFRINGENCE DETERMINED BY POLARIZATION METHOD; DATA EXTRACTED FROM A SMOOTH CURVE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
3	87	CHANDRASEKHAREN,V. DAMANY,H.	1969	I	0.12-0.18	293	SYNTHETIC CRYSTAL; OBTAINED FROM OPTOVAC,INC.; PLATE SPECIMEN; 0.493MM THICK; CUT WITH OPTIC AXIS PARALLEL TO THE SURFACE AND POLISHED; REFRACTIVE INDEX DETERMINED BY INTERFERENCE PATTERN OF CHANNEL SPECTRA; DATA EXTRACTED FROM A TABLE; TEMPERATURE NOT GIVEN, 293K ASSUMED.
4	87	CHANDRASEKHAREN,V. ET AL.	1969	I	0.11-0.17	293	SIMILAR TO ABOVE BUT FOR A SPECIMEN OF 0.093MM THICK.
5	88	MODINE,F.A. MAJOR,R.W. SONDER,E.	1975	H	0.24-0.70	293	SINGLE CRYSTAL; PLATE SPECIMEN; 0.093CM THICK; BIREFRINGENCE DETERMINED BY A HIGH FREQUENCY MODULATION METHOD UTILIZING A PHOTOELASTIC POLARIZATION MODULATOR; DATA EXTRACTED FROM A FIGURE; TEMPERATURE NOT GIVEN, 293K ASSUMED.

TABLE 44. EXPERIMENTAL BIREFRINGENCE OF MAGNESIUM FLUORIDE (WAVELENGTH DEPENDENCE)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; BIREFRINGENCE , Δn, 10^{-3})

λ	Δn
DATA SET 1	
T = 293.0	
0.15807	14.307
0.15365	14.221
0.15632	14.275
0.15952	14.237
0.16260	14.193
0.16558	14.140
0.16922	14.073
0.17265	14.008
0.17609	13.930
0.17967	13.849
0.18341	13.765
0.18753	13.694
0.19187	13.600
0.19559	13.516
0.20065	13.431
0.20576	13.356
0.21102	13.269
0.21667	13.194
0.22292	13.113
0.22933	13.025
0.23619	12.935
0.24394	12.855
0.25221	12.790
0.26018	12.700
0.27030	12.611
0.28124	12.551
0.29382	12.503
0.30632	12.427
0.31985	12.327
0.33531	12.242
DATA SET 2	
T = 293.0	
0.1972	13.40
0.2046	13.25
0.2177	13.09
0.2285	12.98
0.2421	12.77
0.2535	12.66
0.2654	12.53
0.2735	12.46
0.2951	12.41
0.3090	12.30
0.3243	12.21
0.3451	12.10
0.3715	12.03
0.4083	11.94
0.4415	11.88
0.4809	11.85
0.5116	11.82
0.5482	11.76
0.5902	11.71
0.6531	11.69
0.7063	11.62
0.7655	11.62
0.7961	11.57
0.9709	11.50
0.9332	11.44
1.0000	11.44
1.0715	11.45
1.1376	11.40
1.2274	11.40
1.3335	11.40
1.4158	11.32
1.5524	11.32
1.6788	11.24
1.9535	11.21
2.0464	11.14
2.1478	11.11
2.2646	11.11
2.4099	11.04
2.5644	10.97
2.7227	10.91
2.9444	10.70
3.1550	10.60
3.4594	10.41
3.6141	10.27
3.8195	10.02
4.0926	9.75
4.4567	9.41
4.8866	8.94
5.1525	8.59
5.4327	8.22
5.7544	7.81
6.0117	7.31
6.3387	6.75
6.5919	6.34
6.8709	5.76
7.0636	5.22
7.4822	4.49
7.7627	3.73
7.9617	3.26
8.0912	2.76
8.2795	2.31
DATA SET 3	
T = 293.0	
0.12028	1.952
0.12037	2.197
0.12050	2.442
0.12059	2.691
0.12073	2.939
0.12087	3.187
0.12100	3.436
0.12120	3.688
0.12132	3.937
0.12144	4.188
0.12160	4.440
0.12172	4.691
0.12187	4.944
0.12202	5.200
0.12221	5.454
0.12238	5.709
0.12256	5.966
0.12277	6.226
0.12295	6.484
0.12315	6.744
0.12338	7.007
0.12350	7.265
0.12384	7.536
0.12409	7.803
0.12436	8.072
0.12463	8.342
0.12493	8.616
0.12524	8.891
0.12558	9.170
0.12595	9.453
0.12634	9.739
0.12674	10.026
0.12722	10.322
0.12772	10.622
0.12826	10.927
0.12893	11.245
0.12971	11.577
0.13059	11.912
0.13155	12.274
0.13228	12.611
0.13505	13.149
0.14532	14.149
0.14946	14.249
0.15295	14.271
0.15619	14.257
0.15940	14.226
0.16260	14.182
0.16578	14.123
0.16906	14.060
0.17243	13.990
0.17590	13.915
DATA SET 4	
T = 293.0	
0.11486	-20.951
0.11502	-19.746
0.11521	-18.542
0.11536	-17.329
0.11558	-16.122
0.11575	-14.903
0.11595	-13.685
0.11619	-12.467
0.11644	-11.244
0.11669	-10.016
0.11693	-8.782
0.11719	-7.544
0.11752	-6.305
0.11782	-5.057
0.11821	-3.805
0.11856	-2.544
0.11901	1.277
0.11949	0.0
0.12001	1.288
0.12058	2.588
0.12135	3.907
0.12215	5.242
0.12318	6.609
0.12447	8.013
0.12613	9.474
0.12861	11.039
0.13423	12.962
0.14720	14.215
0.16480	14.146
DATA SET 5	
T = 293.0	
0.2457	12.860
0.2493	12.821
0.2538	12.779
0.2583	12.735
0.2638	12.689
0.2688	12.648
0.2732	12.608
0.2785	12.569
0.2857	12.528
0.2906	12.488
0.2994	12.447
0.3048	12.407
0.3125	12.374
0.3194	12.333
0.3289	12.295
0.3389	12.265
0.3460	12.225
0.3571	12.195
0.3663	12.153
0.3831	12.116
0.3968	12.085
0.4098	12.051
0.4237	12.017
0.4385	11.990
0.4566	11.953
0.4761	11.936
0.4926	11.905
0.5181	11.876
0.5405	11.851
0.5681	11.826
0.5952	11.801
0.6250	11.774
0.6578	11.757
0.7042	11.736

TABLE 45. COMPARISON OF DISPERSION EQUATIONS PROPOSED FOR MgF_2

Source	Wavelength and Temperature Ranges	Dispersion Equation λ in μm; ν in cm^{-1}
Duncanson, A. and Stevenson, R.W.H. 1958	0.40-0.70 μm 294 K	$n = 1.36957 + \frac{35.821}{\lambda - 1492.5}$ for ordinary ray,
		$n = 1.38100 + \frac{37.415}{\lambda - 1494.7}$ for extraordinary ray.
Eastman Kodak Co. 1971	1.0-9.0 μm 293 K	$n = 1.3776955 + \frac{1.3515529 \times 10^{-3}}{\lambda^2 - 0.028} + \frac{2.1254394 \times 10^{-4}}{(\lambda^2 - 0.028)^2} -$
		$- 1.5041172 \times 10^{-3} \lambda^2 - 4.4109708 \times 10^{-6} \lambda^4$
		for IRTRAN 1.
Present work 1977	0.15-10.0 μm 293 K	$n^2 = 1.27620 + \frac{0.60967 \lambda^2}{\lambda^2 - (0.08636)^2} + \frac{0.00800 \lambda^2}{\lambda^2 - (18.0)^2} + \frac{2.14973 \lambda^2}{\lambda^2 - (25.0)^2}$ for ordinary ray,
		$n^2 = 1.25385 + \frac{0.66405 \lambda^2}{\lambda^2 - (0.08504)^2} + \frac{1.08987 \lambda^2}{\lambda^2 - (22.2)^2} + \frac{0.18159 \lambda^2}{\lambda^2 - (24.4)^2} +$
		$+ \frac{2.12272 \lambda^2}{\lambda^2 - (40.6)^2}$ for extraordinary ray,
		$n^2 = 1.79079 + \frac{0.10822 \lambda^2}{\lambda^2 - (0.16733)^2} + \frac{2.78138 \lambda^2}{\lambda^2 - (25.54)^2}$
		for IRTRAN 1.

3.5 Calcium Chloride, $CaCl_2$

Available data on the refractive index of calcium chloride are given in tables 46 and 47, and are plotted in figure 26, where data for hydrated calcium chloride and molten salt are also presented for comparison. As the refractive index was measured only for the single spectral line (0.589 micrometer) and the material is not suitable for optical applications, data analysis and data prediction were not attempted.

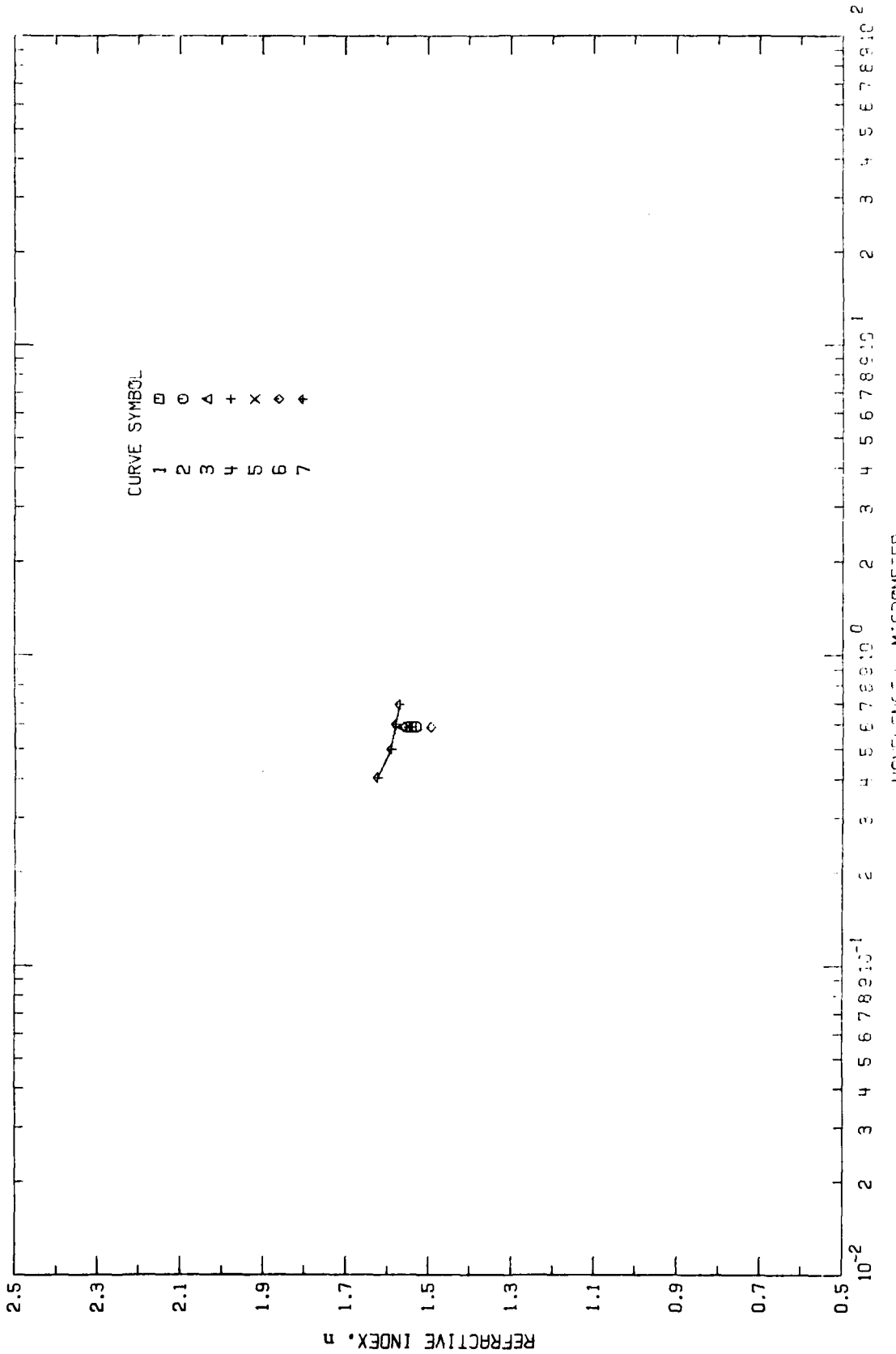


FIGURE 26. REFRACTIVE INDEX OF CALCIUM CHLORIDE (WAVELENGTH DEPENDENCE).

TABLE 46. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF CALCIUM CHLORIDE (WAVELENGTH DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	62	WULFF,P. HEIGL,A.	1931	M	0.589	298	WATER FREE FRAGMENTS OF SINGLE CRYSTAL; REFRACTIVE INDEX DETERMINED BY IMMERSION METHOD FOR THE MEAN OF SODIUM D LINES; MAXIMUM VALUE OF REFRACTIVE INDEX WAS DETERMINED FOR THIS BIREFRINGENT MATERIAL; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF INDEX 0.002.
2	62	WULFF,P. ET AL.	1931	M	0.589	298	SIMILAR TO ABOVE BUT FOR MINIMUM REFRACTIVE INDEX; UNCERTAINTY OF INDEX 0.002.
3	89	WULFF,P. SCHALLER,O.	1934	P	0.589	298	CRYSTAL OF TETRA-HYDRATED CALCIUM CHLORIDE WITH UNKNOWN STRUCTURE; REFRACTIVE INDEX DETERMINED BY A PULFRICH REFRACTOMETER METHOD FOR THE MEAN OF SODIUM D LINES; MAXIMUM VALUE OF INDEX OBTAINED; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF INDEX AT THE THIRD DECIMAL PLACE.
4	89	WULFF,P. ET AL.	1934	P	0.589	298	SIMILAR TO ABOVE BUT FOR MINIMUM VALUE OF INDEX; UNCERTAINTY OF INDEX AT THE THIRD DECIMAL PLACE.
5	89	WULFF,P. ET AL.	1934	P	0.589	298	CRYSTAL OF HEXA-HYDRATED CALCIUM CHLORIDE WITH HEXAGONAL STRUCTURE; REFRACTIVE INDEX DETERMINED BY A PULFRICH REFRACTOMETER METHOD FOR THE MEAN OF SODIUM D LINES; INDEX OF ORDINARY RAY OBTAINED; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF INDEX 0.001.
6	89	WULFF,P. ET AL.	1934	P	0.589	298	SIMILAR TO ABOVE BUT FOR EXTRAORDINARY RAY; UNCERTAINTY OF INDEX 0.001.
7	90	MARCOUX,J.	1971	F	0.4-0.7	1045	MOLTEN SALT; VYCOR TUBE FILLED WITH THE MELT FORMED A CYLINDRICAL LENS; REFRACTIVE INDEX DETERMINED BY FOCAL LENGTH DETERMINATION METHOD FOR 4 SPECTRAL LINES; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF INDEX 0.005.

TABLE 47. EXPERIMENTAL REFRACTIVE INDEX OF CALCIUM CHLORIDE (WAVELENGTH DEPENDENCE)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n)

λ	n
DATA SET 1	
T = 298.0	
0.589	1.542
DATA SET 2	
T = 298.0	
0.589	1.531
DATA SET 3	
T = 298.0	
0.589	1.566
DATA SET 4	
T = 298.0	
0.589	1.548
DATA SET 5	
T = 298.0	
0.589	1.5504
DATA SET 6	
T = 298.0	
0.589	1.4949
DATA SET 7	
T = 1045.	
0.4047	1.623
0.5000	1.590
0.6000	1.580
0.6943	1.570

3.6 Strontium Chloride, $SrCl_2$

The structure of $SrCl_2$ is of the CaF_2 type. The space group is O_h^5. There has been considerable interest in $SrCl_2$, CaF_2, BaF_2, and SrF_2. One of the reasons for this interest is that these crystals are nearly ideal host lattices for paramagnetic ions. Many electronic excitation and magnetic resonance experiments have been performed on rare earth ions and other ions in these materials. For some of these investigations, the host lattice was $SrCl_2$. It is of some importance to study the optical properties of pure strontium chloride.

$SrCl_2$ single crystals are highly hygroscopic. The hydrated form $SrCl_2 \cdot H_2O$ readily comes into being when $SrCl_2$ crystals are exposed to air. Special precautions are necessary when growing the crystals, and preparing and storing the samples. The crystals can be grown in an inert gas atmosphere by the Czochralsky method. Grinding and polishing the sample surfaces can be accomplished with an abrasive dispersed in a waterfree organic liquid. For storage the material should be immersed in a waterfree organic liquid, such as paraffin oil.

Direct measurement on the refractive index of $SrCl_2$ was reported by Wulff and Heigl [62] for only a single spectral line at 0.589 micrometer, as given in tables 48 and 49, and figure 27, where the refractive index of hydrated strontium chloride is also listed for the purpose of comparison. This single value is probably the only directly measured value available. Another

investigation on the refractive index was carried out by Droste and Geick [91], in which the refractive index was deduced from the reflection spectrum by Lorentz theory. As the available data is very scanty and the material is not suitable for optical application, no attempt was made at data analysis and data prediction. We present only the available raw data as shown in tables 48 and 49, and the following related properties:

$$\varepsilon_0 = 7.55,$$

$$\varepsilon_\infty = 2.86,$$

$$\lambda_{TO} = 134 \text{ cm}^{-1},$$

and

$$\lambda_{LO} = 223 \text{ cm}^{-1}.$$

The above values were taken from Ref [91].

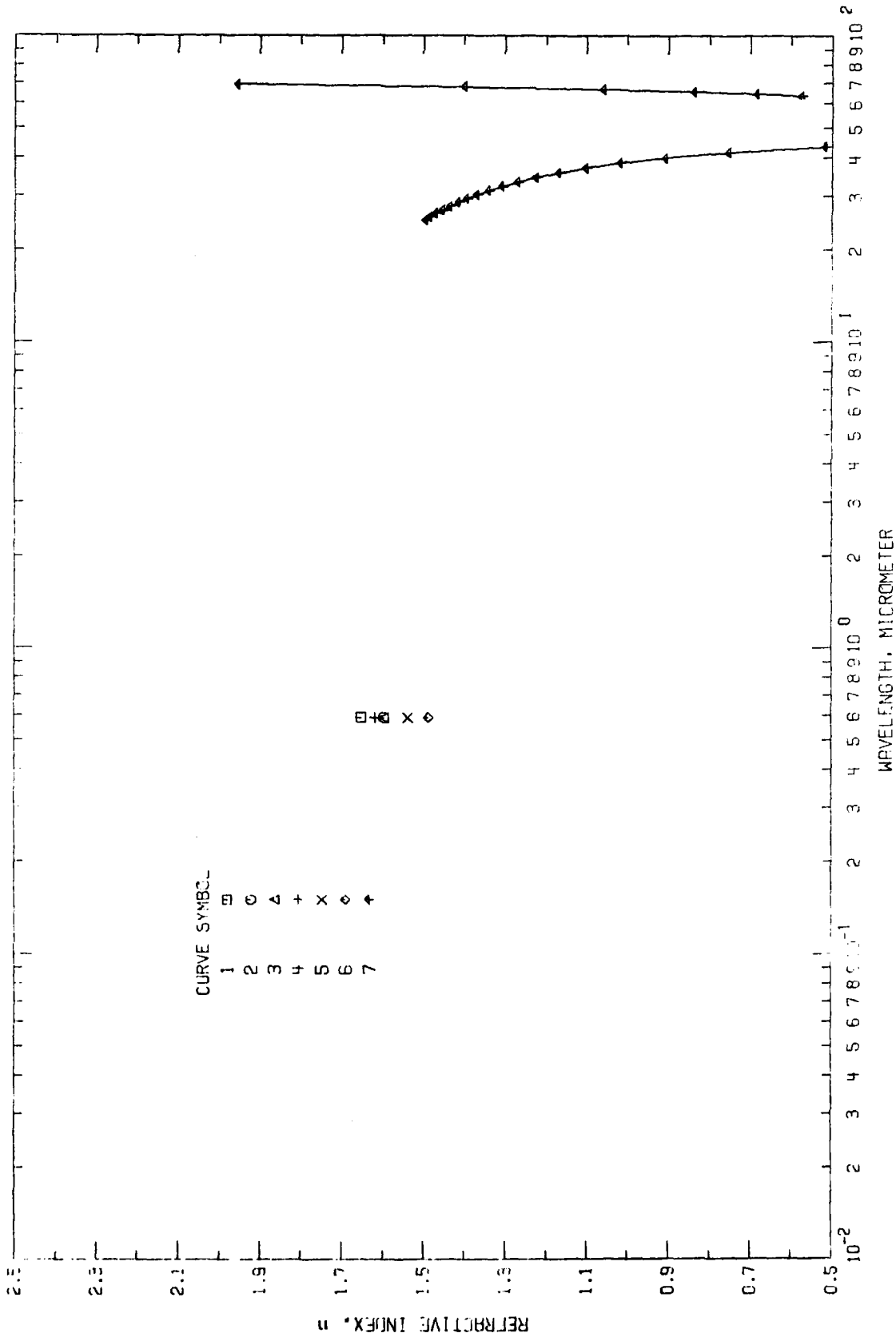


FIGURE 27. REFRACTIVE INDEX OF STRONTIUM CHLORIDE (WAVELENGTH DEPENDENCE).

TABLE 48. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF STRONTIUM CHLORIDE (WAVELENGTH DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	62	WULFF,P. HEIGL,A.	1931	M	0.589	298	SINGLE CRYSTAL; 1-2 MM FRAGMENTS; OBTAINED FROM COOLING THE MELT; REFRACTIVE INDEX DETERMINED BY IMMERSION METHOD FOR THE MEAN OF SODIUM D LINES; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF INDEX 0.00003.
2	62	WULFF,P. ET AL.	1931	P	0.589	298	CRYSTAL OF DI-HYDRATED STRONTIUM CHLORIDE OF MONOCLINIC STRUCTURE; REFRACTIVE INDEX DETERMINED BY A PULFRICH REFRACTOMETER METHOD FOR THE MEAN OF SODIUM D LINES; REFRACTIVE INDEX FOR RAYS ALONG A-AXIS OBTAINED; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF INDEX 0.0002.
3	62	WULFF,P. ET AL.	1931	P	0.589	298	SIMILAR TO ABOVE BUT FOR RAYS ALONG B-AXIS; UNCERTAINTY OF INDEX 0.0004.
4	62	WULFF,P. ET AL.	1931	P	0.589	298	SIMILAR TO ABOVE BUT FOR RAYS ALONG C-AXIS; UNCERTAINTY OF INDEX 0.0001.
5	62	WULFF,P. ET AL.	1931	P	0.589	298	CRYSTAL OF HEXA-HYDRATED STRONTIUM CHLORIDE OF TRIGONAL STRUCTURE; REFRACTIVE INDEX DETERMINED BY A PULFRICH REFRACTOMETER METHOD FOR THE MEAN OF SODIUM D LINES; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF INDEX 0.00003; REFRACTIVE INDEX FOR ORDINARY RAY OBTAINED.
6	62	WULFF,P. ET AL.	1931	P	0.589	298	SIMILAR TO ABOVE BUT FOR EXTRAORDINARY RAY; UNCERTAINTY OF INDEX 0.0003.
7	91	DROSTE,R. GEICK,R.	1974	R	25-250	300	SINGLE CRYSTAL; GROWN BY A CZOCHRALSKY METHOD; ANEALED AT 923K FOR 24 HOURS; REFRACTIVE INDEX DEDUCED FROM REFLECTION SPECTRUM WITH LORENTZ THEORY; DATA EXTRACTED BY EVALUATING A GIVEN EQUATION.

TABLE 49. EXPERIMENTAL REFRACTIVE INDEX OF STRONTIUM CHLORIDE (WAVELENGTH DEPENDENCE)

(WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n)

λ	n
DATA SET 1	
T = 298.0	
0.589	1.64986
DATA SET 2	
T = 298.0	
0.589	1.5942
DATA SET 3	
T = 299.0	
0.589	1.5948
DATA SET 4	
T = 298.0	
0.589	1.6172
DATA SET 5	
T = 298.0	
0.589	1.53560
DATA SET 6	
T = 298.0	
0.589	1.48565
DATA SET 7	
T = 300.0	
25.00	1.492
25.64	1.480
26.31	1.466
27.03	1.450
27.78	1.433
28.57	1.413
29.41	1.392
30.30	1.367
31.25	1.338
32.26	1.305
33.33	1.266
34.48	1.221
35.71	1.166
37.04	1.099
38.46	1.014
40.00	0.903
41.67	0.749
43.48	0.514
45.45	0.240
47.62	0.176
50.00	0.171
52.63	0.188
53.33	0.196
54.05	0.205
54.79	0.215
55.56	0.228
56.34	0.243
57.14	0.261
57.97	0.283
58.82	0.309
59.70	0.341
60.61	0.379
61.54	0.428
62.50	0.490
63.49	0.572
64.52	0.691
65.57	0.833
66.67	1.055
67.80	1.396
68.97	1.952
70.18	2.900
71.43	4.431
72.73	6.094
74.07	6.719
75.47	6.455
76.92	5.976
78.43	5.528
80.00	5.155
81.63	4.849
83.33	4.598
85.11	4.349
86.96	4.213
88.89	4.063
90.91	3.933
93.02	3.820
95.24	3.721
97.56	3.633
100.00	3.555
111.11	3.313
125.00	3.147
142.86	3.027
166.67	2.939
200.00	2.873
250.00	2.825

3.7 Barium Chloride, $BaCl_2$

Available data on the refractive index of barium chloride are given in tables 50 and 51, and are plotted in figure 28, where data for hydrated barium chloride are also presented for comparison. As the refractive index was measured only for a single spectral line, 0.589 micrometer, and the material is not suitable for optical application, data analysis and data prediction were not attempted.

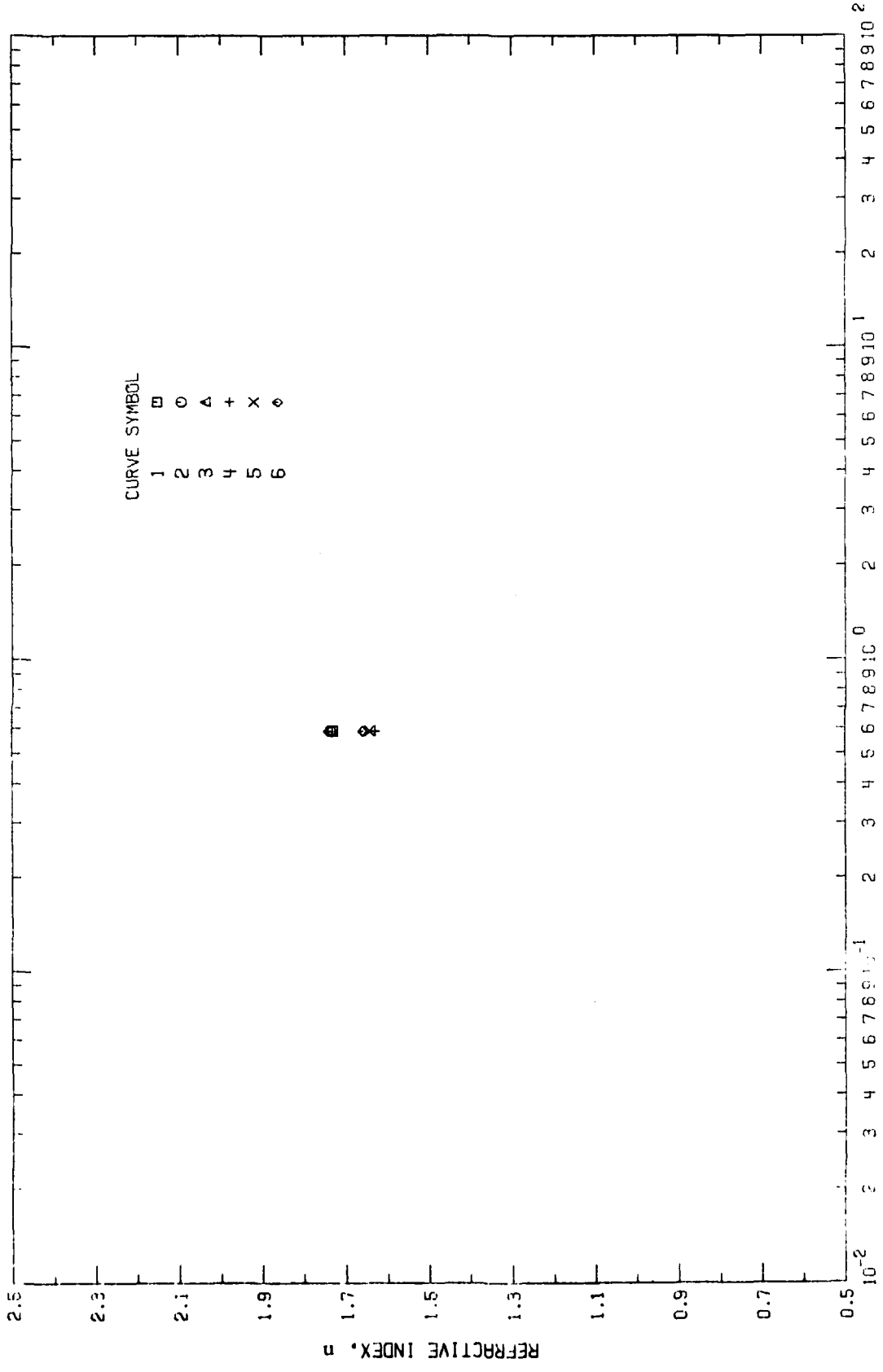


FIGURE 28. REFRACTIVE INDEX OF BARIUM CHLORIDE (WAVELENGTH DEPENDENCE).

TABLE 58. MEASUREMENT INFORMATION ON THE REFRACTIVE INDEX OF BARIUM CHLORIDE (WAVELENGTH DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVELENGTH RANGE, μm	TEMP. K	SPECIFICATIONS AND REMARKS
1	62	WULFF,P. HEIGL,A.	1931	P	0.589	298	BIAXIAL CRYSTAL; PRODUCED BY SLOWLY COOLING OF THE MELT; REFRACTIVE INDE) DETERMINED BY A PULFRICH REFRACTOMETER FOR THE MEAN OF SODIUM D LINES ALONG A-AXIS; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF INDEX 0.00015.
2	62	WULFF,P. ET AL.	1931	P	0.589	298	SIMILAR TO ABOVE BUT FOR RAYS ALONG B-AXIS; UNCERTAINTY OF INDEX 0.00015.
3	62	WULFF,P. ET AL.	1931	P	0.589	298	SIMILAR TO ABOVE BUT FOR RAYS ALONG C-AXIS; UNCERTAINTY OF INDEX 0.00015.
4	62	WULFF,P. ET AL.	1931	P	0.589	298	CRYSTAL OF DI-HYDRATED BARIUM CHLORIDE OF MONOCLINIC STRUCTURE; REFRACTIVE INDEX DETERMINED BY A PULFRICH REFRACTOMETER FOR THE MEAN OF SODIUM D LINES ALONG A-AXIS; DATA EXTRACTED FROM A TABLE; UNCERTAINTY OF INDEX 0.00006.
5	62	WULFF,P. ET AL.	1931	P	0.589	298	SIMILAR TO ABOVE BUT FOR RAYS ALONG B-AXIS; UNCERTAINTY OF INDEX 0.00010.
6	62	WULFF,P. ET AL.	1931	P	0.589	298	SIMILAR TO ABOVE BUT FOR RAYS ALONG C-AXIS; UNCERTAINTY OF INDEX 0.00010.

TABLE 51. EXPERIMENTAL REFRACTIVE INDEX OF BARIUM CHLORIDE (WAVELENGTH DEPENDENCE)

[WAVELENGTH, λ, μm; TEMPERATURE, T, K; REFRACTIVE INDEX , n]

λ	n
DATA SET 1	
T = 298.0	
0.589	1.73024
DATA SET 2	
T = 298.0	
0.589	1.73611
DATA SET 3	
T = 298.0	
0.589	1.74196
DATA SET 4	
T = 298.0	
0.589	1.62985
DATA SET 5	
T = 298.0	
0.589	1.64191
DATA SET 6	
T = 298.0	
0.589	1.65829

4. CONCLUSIONS AND RECOMMENDATIONS

Experimental data on the refractive index of alkaline earth halides and its temperature derivative are exhaustively surveyed and reviewed. In addition, values of physical properties which are related to the dispersion phenomena are selected from the open literature.

Of the twenty alkaline earth halides, only the four fluorides (MgF_2, CaF_2, SrF_2 and BaF_2) are suitable for optical applications; others are either physically inadequate or chemically too unstable for utilization. As a consequence, available data on the refractive index and its temperature derivative largely concern the four fluorides.

The purpose of the present work was to survey and compile the available data and to generate recommended values of the refractive index and its temperature derivative for alkaline earth halides. We have generated recommended values for the four fluorides (as shown in figures 29, 30, and 31). The state of knowledge on the refractive index of this group of materials is also presented.

The technology related to high-power infrared lasers is progressing rapidly and, consequently, there is an increasing need to determine the effects that exposures to high-power light beams have on materials. Among other things, refractive indices at elevated temperatures are needed. Unfortunately, an

exhaustive survey of the open literature, as in the present work, shows that refractive indices as a function of wavelength are only available near room temperature. Measurements on the refractive index at higher temperatures are limited to a few wavelengths. In a few cases, the temperature derivative of the refractive index has also been measured in the vicinity of room temperature. Even though it is clear that high temperature data are lacking, recent measurements reported in the open literature were still carried out at near room temperature. Consequently, our basic knowledge of the refractive index at high temperatures is still scanty. For the purpose of providing data useful to modern science and technology, as well as for the future development of optical devices, a well planned and systematic program of measurement of the refractive index of selected materials over a wide range of temperatures and wavelengths is highly recommended.

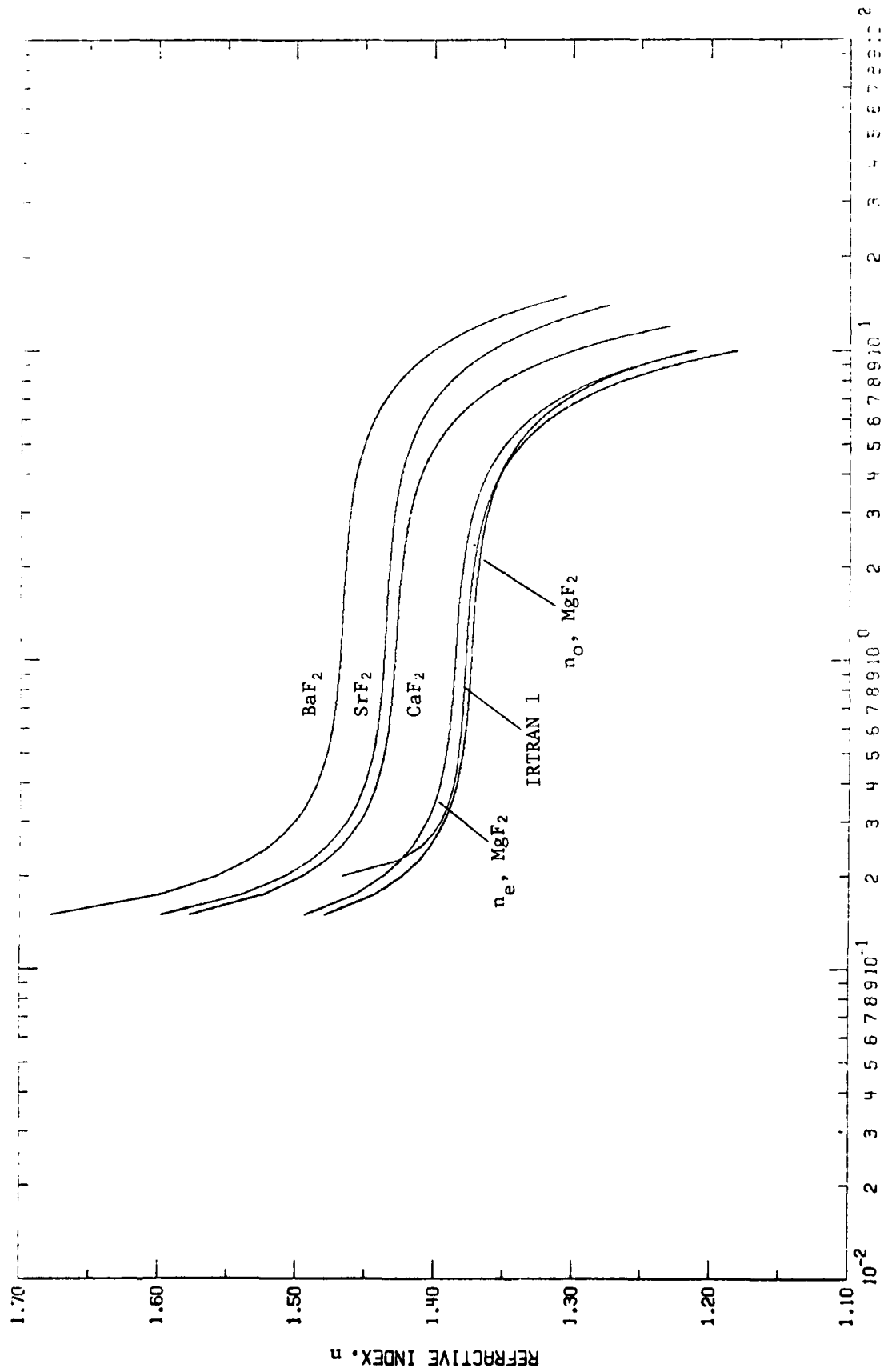


FIGURE 29. REFRACTIVE INDEX OF ALKALINE EARTH HALIDES (WAVELENGTH [illegible]

AD-A129 101 REFRACTIVE INDEX OF ALKALINE EARTH HALIDES AND ITS WAVELENGTH AND TEMPERATURE DERIVATIVES(U) THERMOPHYSICAL AND ELECTRONIC PROPERTIES INFORMATION ANALYSIS .. H H LI SEP 77 CINDAS-44 F/G 7/2 NL

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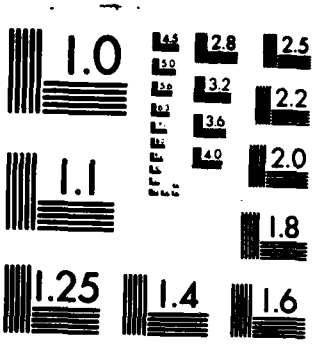

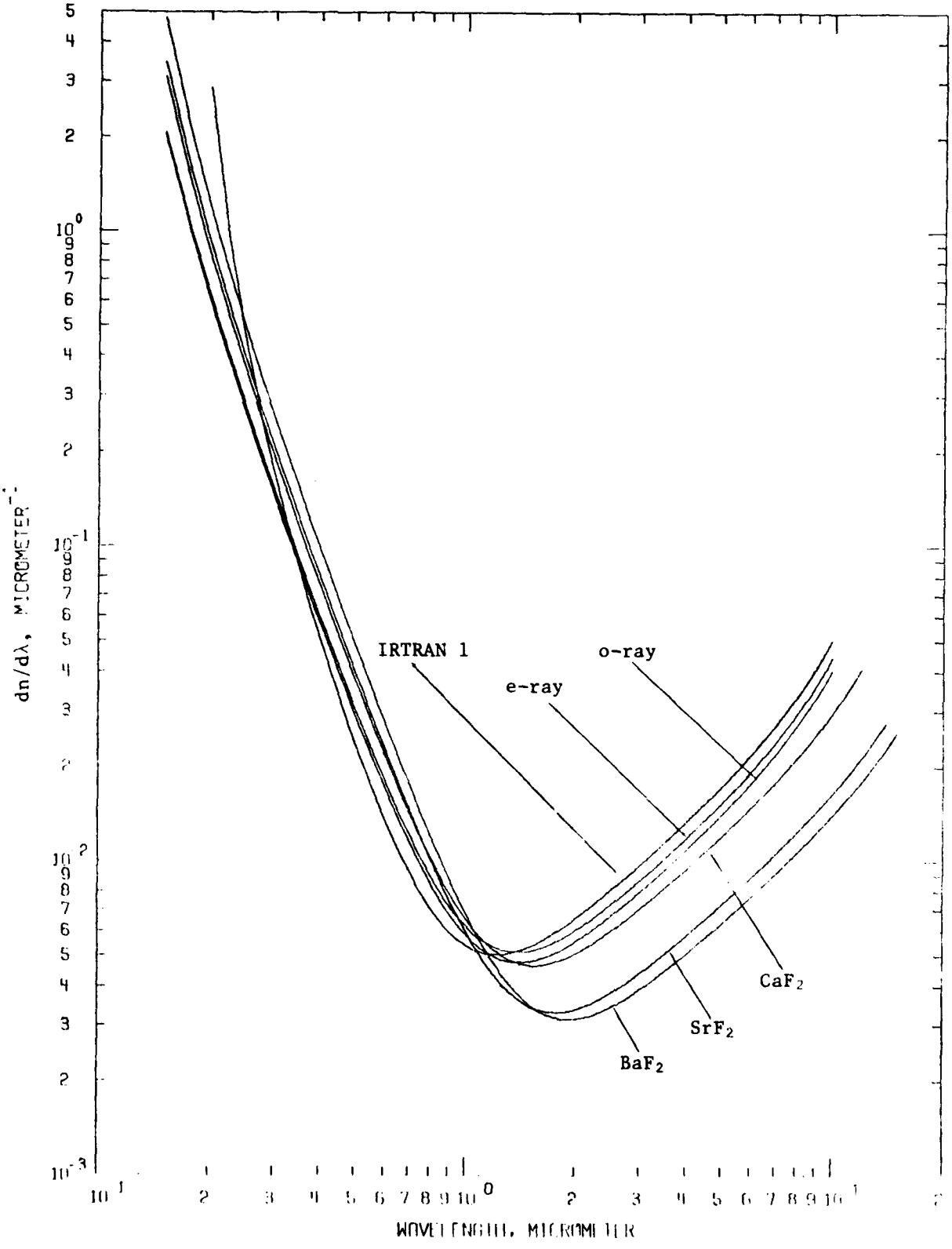

FIGURE 50. WAVELENGTH DERIVATIVE OF REFRACTIVE INDEX OF [illegible]

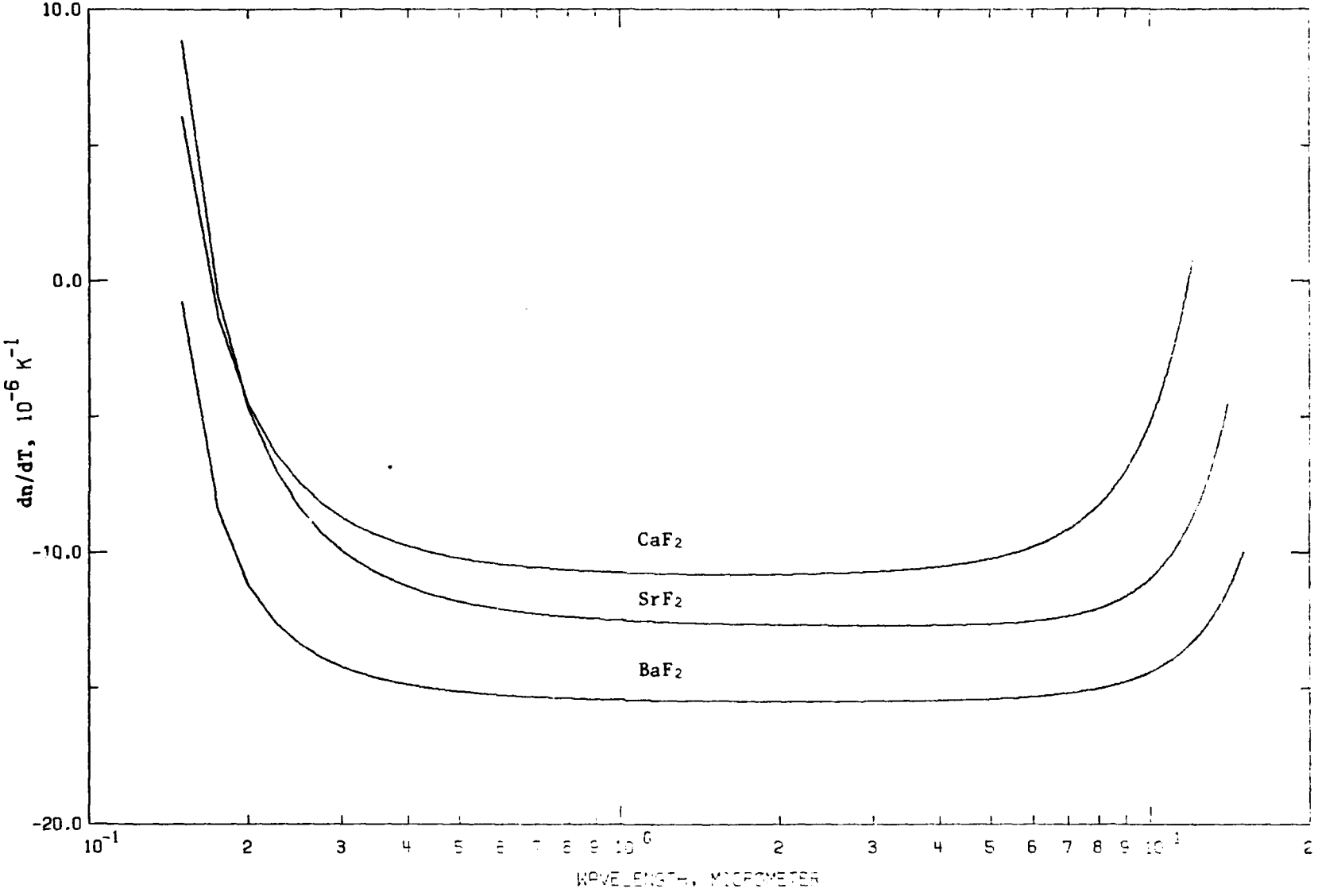

FIGURE 31. TEMPERATURE DERIVATIVE OF REFRACTIVE INDEX OF ALKALINE EARTH HALIDES (WAVELENGTH DEPENDENCE).

5. ACKNOWLEDGMENT

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